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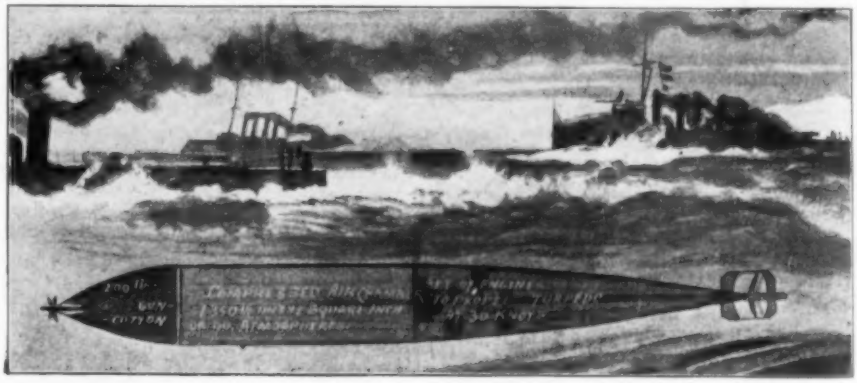
The Torpedo--War's Deadliest Weapon

One of the World's Most Ingenious Mechanisms--Description of Its Construction and Operation

"At its nose a small metal pin. Behind the small metal pin a little fulminate of mercury. Behind the fulminate of mercury a wisp of dry guncotton. Behind the wisp of dry guncotton a mass of wet guncotton. Behind the wet guncotton a braced chamber nearly bursting with compressed air. Behind the compressed air a set of panting cylinders. Behind everything a set of excited double-bladed screws. The whole little water mole burrowing through the waves at the rate of 30 knots an hour. The dark, stupendous interposing bulk of a battleship. A sudden jar. The small metal pin nudges the fulminate of mercury. The fulminate of mercury whispers to the guncotton. An explosion and an upheaval."

This is the torpedo and its mission, as has been told, in a nutshell. When the explosion comes it is all over with the battleship. The little mechanical "water mole" has worked the complete destruction of its giant object of attack. A great hole has rent the warship's hull. The vessel reels, tips, screaks; the sailors and crew amid pandemonium and death wrought by the bursting of the oblong submarine shell, struggle wildly for the lifeboats; the ship gives a sudden lunge and down toward the bottom it goes. Above it curls the whirlpool, and then, on the water calming, is the debris of the wreck and those that are not dead still struggling for life.

This is the work of the torpedo and its life's mission is done. It is the deadliest, most stealthful, most ingenious instrument of war. It has been declared to display the



A Torpedo in Flight--Sectional View Showing Interior

most wonderful mechanical ingenuity of any machine ever constructed by man. The torpedo is so built that when fired it cannot swerve or deviate from an absolutely straight course and the most powerful ship the world has ever built is as surely doomed as it is struck by a Whitehead torpedo.

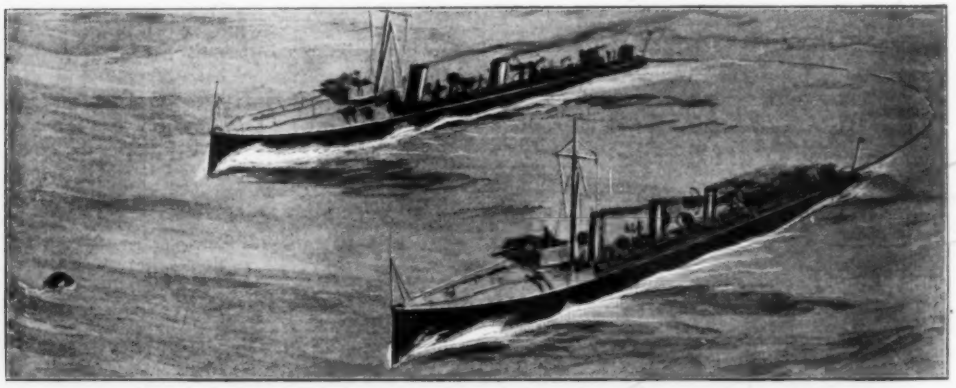
Deadly, powerful and ingenious as they are, the use of torpedoes is so far restricted, because of the perils necessarily encountered in using them. The torpedo boat, from which they are generally fired, is the frailest of craft, a rifle shot being sufficient to sink most of them. England, however, has lately produced some remarkably substantial torpedo boats. They have proven themselves seaworthy in a gale, a feat never accomplished before. Next to England the United States has the most substantial of the boats, several of which have been described in Popular Mechanics. Japan's torpedo boats and torpedoes were built in England and represent a high efficiency of workmanship, but not England's best.

The net is the only protection against the attack of torpedoes and they, until recent trials before the Prince of Wales at Portsmouth, England, have proved very unsuccessful. In the mimic battle in which submarines and battleships participated, a submarine torpedo boat was captured in a net by battleship picket boats. The ingenious expedient by which the boat was literally picked up out of the water was the conception of Admiral Wilson. The officers on the picket boats attached to one of the nets saw a periscope moving on the face of the water and they maneuvered so as to make the net bar its progress. A few moments later a straining at the hawser told them that they had stopped the progress of the submarine. Immediately the boat altered its course so as completely to envelope the unfortunate under-water craft in the net.

The poor little vessel found itself in the toils and as the hawser had carried away the periscope, the sole means of seeing what was happening on the surface, the crew could do nothing but await developments. The submarine was raised to the surface and the crew had the most startling experience of record. The officers will not soon forget how they were caught like fish in a cleverly planned steel sieve.

The torpedo is successful only when there can be found men ready to sacrifice their lives in operating it. The chances are about even that they who start out to torpedo a vessel will never return alive. No insurance company will take the risk of insuring their lives.

By seamen the torpedo is called the "baby." It is shaped like a cigar and is from 14 to 18 inches in diameter at the thickest part, and from 14 to 20 feet long.



Destroyers Capturing a Submarine in a Net, Guided by the Submarine's Periscope, Which, as Seen in the Picture, Looks Like a Ball Floating on the Water

The latest and largest size weighs 1,150 pounds and has a speed of 32 knots for 2,000 yards. The 14-inch or smaller projectile has a speed of 30 knots for 2,000 yards and weighs 706 pounds.

The torpedo is the most wonderful of all projectiles, if it may be called a projectile. It is a self-propelled, self-steering, self-operating mechanical projectile, that once fired, performs its duty of death with

Japanese Firing Torpedoes at Russian War Vessels Off Port Arthur

almost human skill. It is a kind of automatic submarine boat, built at a cost of $3,000, for a single trip on which depends its success or failure. It is built with utmost pains and carefully kept until the time for it to start on its one and final errand of destruction and give it's puny life for the life of a ship. Thus the torpedo is the costliest as well as the most formidable projectile of war. The torpedo boat, as its name implies, is the craft generally intrusted with the firing of torpedoes, although they are made part of the munition of all warships. Their success in the latter capacity, however, has never been satisfactorily demonstrated. There are several makes of the projectile, the most successful of which is the Whitehead, named for its inventor, a mechanic of Fiume, Hungary, where the largest torpedo factory is now located. Torpedoes for the American navy are built at Brooklyn, under a license from the patentees. There are factories in England and Germany.

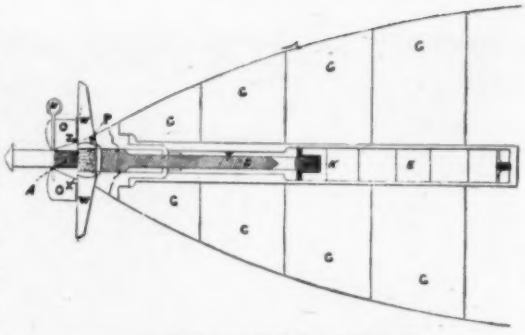
Torpedoes are fired from torpedo tubes, above and below water, generally above. The torpedo after striking the water, sinks itself slightly below the surface and then proceeds on a bee line for the object at which it was fired.

The form of tube now being issued to the navy for broadside firing is about 30 feet long. The lower section of the forward half is cut away, leaving a long overhanging spoon sticking out. Inside the cylinder, on the top, is a T slot, extending from the breech to the end of the spoon. In this T slot fits a small T projection on the top of the torpedo. Suspended by this projection the torpedo balances, so as it is sent out of the tube the T carries it out to the tip of the spoon in a horizontal position, and, slipping out of the slot, the torpedo strikes the water nearly level. Without the suspension arrangements the nose of the torpedo would dive down as it slipped over the forward edge of the tube, resulting in a deep initial dive.

The torpedo is blown out of the tube, either by compressed air, suddenly injected into the rear end, or by an impulse charge of a few ounces of powder. When the projectile strikes the water, the resistance starts a fan, near the front end of the striker, to revolving on a screw thread. When the torpedo has gone 14 yards this fan has run off the thread and drops, leaving the striker unhooded and unhindered in firing the charge of guncotton behind it when it strikes the hull of the battleship. The engines in the torpedo have started to running at full speed as soon as it enters

The foremost compartment of all in a torpedo is that containing the charge and the pistol with which it is fired. In fitting the warhead with the firing apparatus, the pistol and primer charge is inserted into its foremost end, all in one piece and screwed in tight. The body of the pistol and the striker tube are made of bronze, and the striker itself is made of nickel plated steel. The explosive head of a torpedo is shown in the diagram. A short distance from the foremost end of the striker is a fan, O, revolving on a screw thread, A. Just abaft this screw thread is another one on which the whiskers, W, are screwed tight. The fan, O, before the torpedo is fired bears up against the whiskers, W, but not too tightly and to prevent its being metal bound against it, a hole, X, is cut in the corner of three of the whiskers, while the fourth is kept closed and bears against a stud, Z. This prevents the fan from being tightened up too much and leaves it free to revolve, for the holes in the three other whiskers enable them to revolve past the stud and by the time the fourth whisker is up to it again, it will have screwed forward to pass. The detonating charge, K, is 38 grains of fulminate of mercury, and the primer charge, E, consists of six 1-ounce discs of dry guncotton contained in a copper cylinder, the foremost end of which, as will be seen, is fixed on the striker tube or the pistol. The rear end of the cylinder is kept tight by an India rubber ring. When the torpedo strikes a rigid object the striker, S, is driven in against the detonator, K, which detonates the primer, E, which in its turn detonates the guncotton charges, G.

It would not do to allow the striker to lie at the mercy of any chance blow against its outer end. So three checks are provided against such a contingency. In the first place the striker cannot go back until the little fan, O, has revolved off it. When the torpedo enters the water the fan begins to revolve and travels away from the whiskers until it has run off the screw thread, A. The torpedo runs 40 feet before it has done this. Even then the striker is not in working order unless the blow is a very heavy one, for a little copper pin, P, is standing in the way. Unless the blow is heavy enough to shear this pin, the striker cannot



Torpedo Warhead

be driven back. The shearing pin acts as a guard until the actual blow takes place. Then there is a third precaution in the shape of the safety pin, M, which holds the fan, O, fixed until it is withdrawn at the last moment as the torpedo is launched into the tube. When all is ready for firing a torpedo the safety pin, M, is removed. As the torpedo rushes through the water, the fan, O, begins to revolve until on reaching a distance of 14 yards when it has run off the screw thread—and the striker is no longer hindered by it. Then when the torpedo strikes the object the striker is driven violently inwards, the pin, P, is sheared and the point of the striker is driven against the detonator, K, and the torpedo explodes.

The head of a torpedo is packed with slabs of guncotton about 1½ inches thick, cut into quadrants, and 17 per cent of added water, besides being very carefully placed so as to fit closely around the primer canister. The guncotton charge is kept permanently stowed in the warhead, the shell of which is made of phosphor-bronze 1-16 inch thick, the pistol socket and the base-ring being firmly screwed to the shell by screw rivets, and the joint is afterward carefully soldered to prevent leakage.

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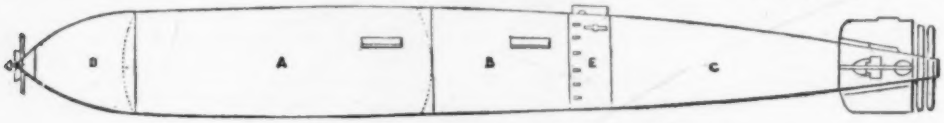
the water and all its wonderful machinery is now in full operation. The engines, run by compressed air, revolve the propeller screw and give the projectile its speed. On striking any hard object, the striker, which performs the office of the hammer of a revolver, is driven back violently, exploding a fulminate of mercury cap, then the dry and then the wet guncotton. There is a great



Latest Type Whitehead Torpedo

A.—Air Chamber. B.—Balance Chamber. C.—Buoyancy Chamber. D.—Explosive Head. E.—Engine Room.

upheaval. The torpedo is no more and the battleship is wrecked.

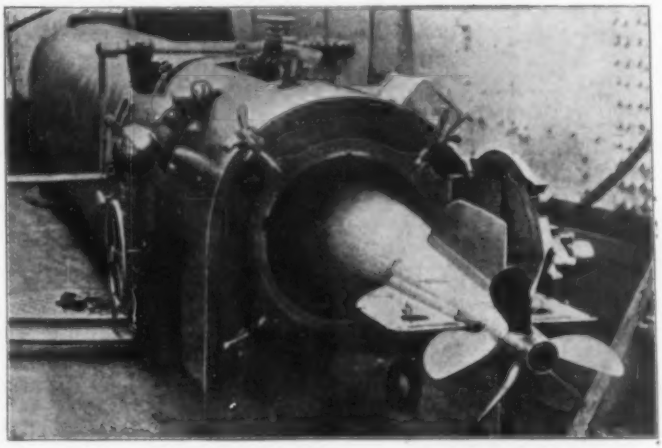
It is the guncotton that causes the awful destructiveness of the torpedo when it explodes. There are 220 pounds of wet guncotton contained in the warhead, the foremost of the several compartments of the projectile. Into this wet guncotton runs a primer of dry guncotton, which is ignited by the striker striking the fulminate of mercury cap as described.

The Whitehead torpedo is made of the finest forged steel or of phosphor bronze, and is divided into several sections. The first section is the firing arrangement. The next is the explosive chamber, in which the guncotton is kept. Then comes the air chamber. The fourth section is the "balance" chamber; the fifth the engine chamber; sixth the buoyancy chamber; seventh the level wheel chamber; eighth the horizontal and vertical rudders and propellers. The several sections are separated by bronze bulkheads.

Compressed air is the motive power. This is contained in the air chamber, or air flask. On shipboard this flask is filled with an air-compressing engine and the pressure attained is 1,350 pounds to the square inch. The flask is tested for a pressure of 2,000 pounds. The air is so compressed that the weight of the ten cubic feet in the flask is 69.19 pounds. A pipe connects the flask

with the torpedo engine room, a small compartment in the forward part of the afterbody.

The engine consists of three cylinders, radiating out from the propeller shaft like a three-leaf clover. The cylinders could be carried in a man's overcoat pocket, but they often have a combined power of 56 horsepower. A main crank, turning the propeller shaft, receives its impulse from the piston of each cylinder in succession. Three slide valves on each cylinder regulate the admission of air. The propeller shafts turn two double-bladed screws in the tail in opposite directions, a gearing in the afterbody giving the reverse motion to one propeller. The two propellers neutralize their individual tendencies to cause the torpedo to roll. To secure the right balance between them the propellers are shaved down after experimental runs.



A Torpedo in Its Tube Showing the Double Propellers

In the balance chamber is located the automatic apparatus which, by means of four rudders, keeps the torpedo in an exactly direct course during its flight and at a proper depth in the water. The buoyancy chamber lies next abaft the engine compartment. The engines are shut off from this chamber by the bulkhead with which they are secured. The chamber contains the necessary apparatus to give buoyancy to the projectile. To insure the torpedo's being always in a perfectly upright position, a certain amount of ballast is kept stowed in the bottom of the chamber.

If the torpedo from any cause be deflected out of the line of fire, the gyroscope, by maintaining its axial position in the line of fire, acts on the servo-motor and by means of the vertical rudders steers the torpedo back again into its original direction.

The hindmost compartment is called the tail. It forms a continuance of the buoyancy chamber and contains the wheel gearing for turning the propellers in opposite directions; the upper and lower perpendicular fins, and the frame holding two horizontal rudders; the vertical rudders and gyroscope vertical rudders; the horizontal rudders and the propellers.

The earlier torpedoes were not cigar-shaped as at present, but had fine tapering heads, the contention being that such shape offered least resistance and assured greater speed. The present form of the projectile was suggested by the shape of the fish, and just why it offers least resistance and gives greater speed is not understood but the fact remains that it does. All the fastest swimming fish are blunt headed and taper away to the tail.

The improved torpedoes can be fired from the fastest ships, while going at full speed, with absolute accuracy of aim, no matter what the bearings or speed of the enemy.

The United States is the birthplace of the torpedo. It was during the Civil War, when

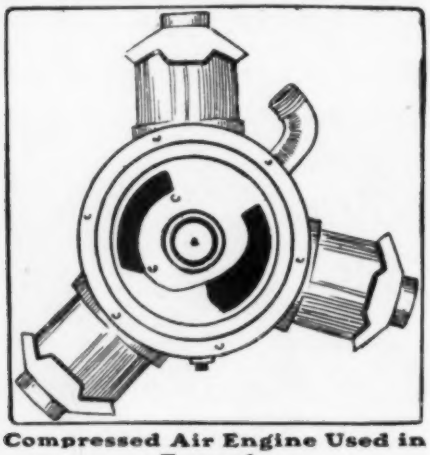
A Submerged Torpedo Tube on Board the Battleship "Peresviet" Now at Port Arthur

Americans opposed Americans, and when "war that was war" raged, that numerous new ideas were brought forth by inventors,

Russian Soldiers Embarking Torpedoes on the "Czarovitch" Eight Hours Before the Commencement of Hostilities

revising the whole practice of naval battles. The ironclad, the turret and the torpedo and the submarine mine were some of the things that grew out of that titanic struggle.

It remained for European countries to develop the torpedo to its present state of



Compressed Air Engine Used in Torpedo

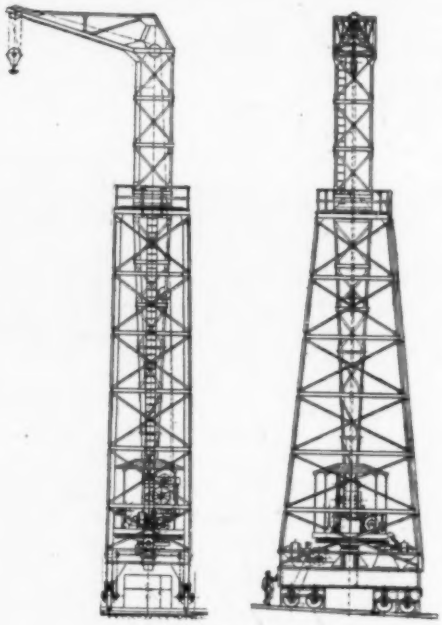
efficiency, however. The Whitehead torpedo factory at Fiume, Hungary, is now managed by an Englishman named A. E. Jones. This company was founded in 1858. It now employs 700 skilled workmen and can turn out two complete torpedoes daily. The employes are nearly all Croatians.

Besides the Whitehead, there are other makes of torpedoes, among which might be mentioned the Spar, which was the original American torpedo and which did great damage during the Civil War; the Brennan; the Howell; the Schwartzkopff; the Peck, an automobile torpedo; the Sims-Edison; the Maxim, a locomotive torpedo; the Lay and Nordenfeldt (automobile torpedo).

AN ELECTRIC TOWER CRANE.

A remarkable electric tower crane for use in constructing tall buildings has been built in Germany.

A tall tower of structural iron, mounted on wheels and capable of moving along a track at the rate of 130 feet per minute supports a steel mast from which projects the boom, the distance from the center of the mast to the hook being nineteen and



Electric Tower Crane.

one-half feet. A single man can control the crane from the lower platform by the use of three motors, one for moving upon the track, one for revolving the mast and one for lifting the load. Loads can be lifted eighty-two and one-half feet.

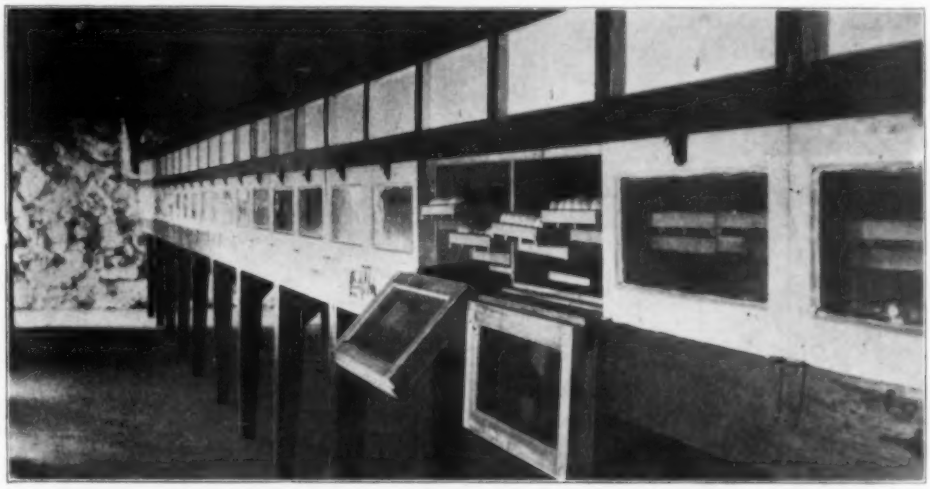
The Electrical Review says: "The crane can lift ten tons with a velocity of sixteen feet per minute, and three tons or less with a velocity of fifty-seven feet per minute."

Mechanical Hen Hatches 300 Chickens Daily

World's Largest Incubator Holds 7,500 Eggs---Is Heated by Hot Water

Nearly three hundred young chickens springing into life every day from a giant machine that does the work of 3,500 hens—this is the performance of a single incubator, the largest chicken factory in the world. The machine is at Ransomville, New York, and is the property of Mr. W. R. Curtiss.

This great mechanical hatchery holds 7,500 eggs, and if all of them were to hatch it would mean 7,500 chicks every three weeks, or more than 370 a day, but of course, allowance must be made for eggs that do not hatch. There are 50 compartments in the incubator, each 24 inches square and each holding two trays of 75 eggs each. The incubator is 51 feet long, and 4 feet 4 inches wide.



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The World's Largest Incubator

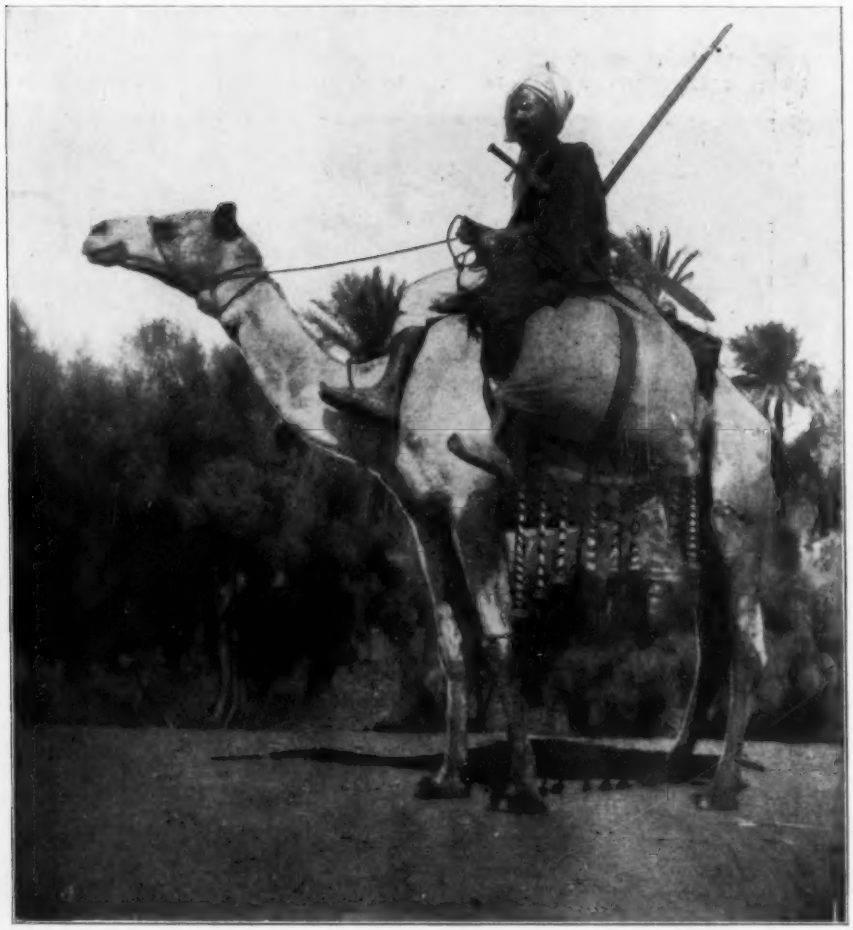
The inventor of this remarkable incubator is W. P. Hall, of Pembrooke, N. Y. The mammoth machine is heated by a hot water system, the jacket stove being located at one end. Over the top of the incubator 16 pipes, each 1¼ inches in diameter, are run, and these heat the compartments. Over the heater there is an expansion tank, 10 by 18 inches, made of galvanized iron. This tank is filled with oil, in which a float operates. As the heat increases the water in the pipes expands and causes the float to rise. This operates a throttle attachment on the float arm and shuts off the draft of the stove, while at the same time another lever opens the cold air draft. This renders it quite impossible to overheat the eggs. The arrangement is exceedingly sensitive.

The heat of the pipes is kept at a steady temperature of about 103 degrees, but as the hatch advances and the eggs develop into chicks there is quite a little animal heat given off by the fertile eggs. This increases the temperature in the compartments, and recognizing the fact the patentee of the incubator has arranged to set the egg trays on a wooden adjuster that can be lowered at various stages to the bottom of the compartment. The open doors of the incubator shown in the picture illustrate clearly the different heights at which the trays can be set. The first drop is made in about six days. In the bottom of the adjuster frame there is a pin designed to set in a series of holes in the bottom of the compartment. As the adjuster frame is hinged as this pin is set forward in the holes, it has the effect of lowering the tray. Each compartment door has a double glass 7 by 20 inches in size, affording a full view of the compartment interior.

It is startling to consider what can be done with such a machine during the normal hatching period, not to speak of the

fact that it can be operated the year round. Estimating the hatching season to open March 1 and to continue until August 1, gives a hatching period of 153 days. It requires 21 days to hatch chickens under a hen or in an incubator, so that in the period referred to the machine could be charged at least seven times, which would call for the use of 52,500 eggs. If 50 per cent of these hatched, it would mean over 26,000 young chicks, and if 75 per cent came out all right the hatch would be over 39,000 chicks. Giving each hen 15 eggs, it would take 3,500 hens to incubate 52,500 eggs, and if only 12 eggs are given to each hen, it would require 4,541 hens to do the work of the incubator.

Rural Letter Carrier of Egypt



Egypt has emulated the example of the United States and established a rural free delivery service. The rural mail carrier of Egypt is a different looking kind of individual from the American carrier, and his equipment is also quite dissimilar. The neatly equipped wagon, such as is furnished by the Rural Free Delivery News of Chicago to the rural mail carriers of the United States, has no place with the Egyptian carrier. To him the camel serves the double purpose of horse and wagon. The camel stalks his way across the desert to rural homes leagues apart and makes better time than the American mail horse. The route of the Egyptian carrier is beset with varied dangers from wild beasts and robber bands and hence he always goes heavily armed, like the carrier shown in the illustration.

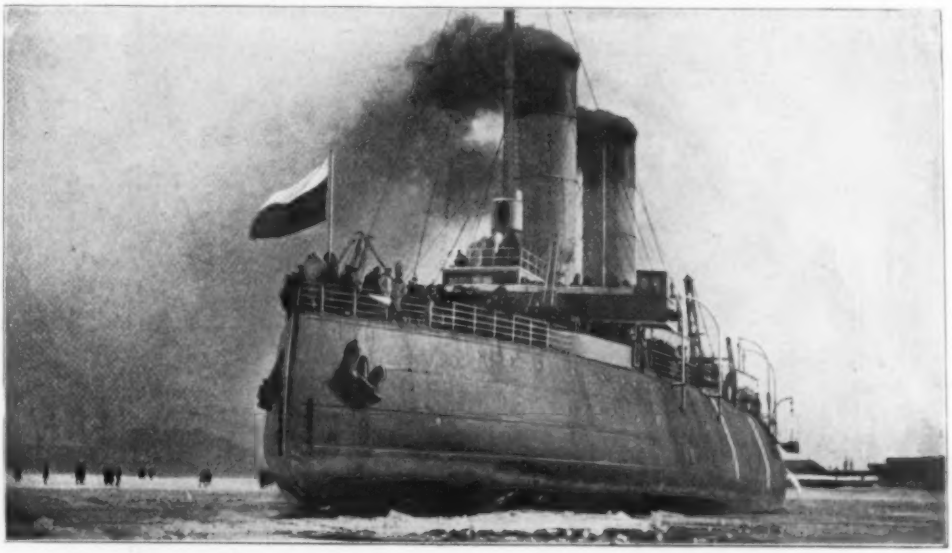
Russia's "King of Ice Crushers"

The Ermak Plows Its Way Through Frozen Seas and Never Falters In Its Course

Forcing its way through the thickest ice, crushing the frozen seas beneath its mighty weight and pursuing its course in the far northern waters directly and uninterruptedly as in a tropical bay, the Russian ice-breaker "Ermak" is the king of ice-crushers and the most effective harbor-opener ever devised. It remained for Russia, the land of ice, to produce an ideal ice-crusher.

The Ermak is of 8,000 tons displacement and 10,000 horsepower. The vessel is so designed that it rides on top of the ice and crushes it beneath its great weight. It is of remarkably substantial construction and although in a continuous collision when making its way through the frozen waters, it has never yet suffered damage. The Ermak has shown that the full forward form, or spoon-shaped bow is not successful in hard and packed ice, as the vessel pushes the ice in front of herself, instead of cutting and dispersing it. The moving parts of the machinery and the shafts must be extra strong and largely in excess of ordinary practice. On the engines it is preferable to have direct steam reversing gear, as the "all round" type is a very heavy tax on the engines when the ship is ice-breaking.

The speed of the Ermak through 24 inches of solid ice, with 6 to 12 inches of snow on it, was 9 knots an hour, and she could charge and demolish packs of ice 20 to 35 feet thick. She has been of great service on the Baltic coast of Russia in assisting vessels out of danger. In one season she rescued and assisted shipping of over $10,000,000 value, and in another winter she salved the Russian battleship Grand Admiral Aprixine, of $3,750,000 value.



Russian Ice-Breaker "Ermak" Forcing Her Way Through Ice in Kronstadt Harbor

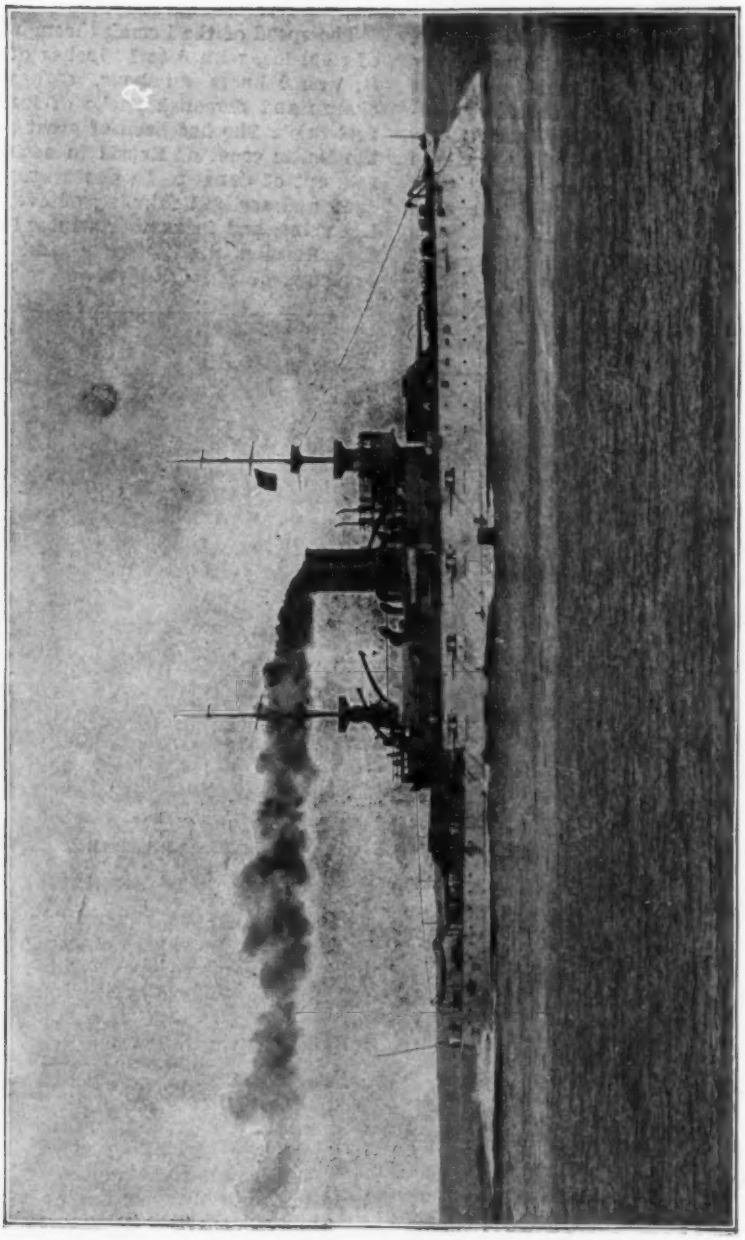
The Russian fleet usually wintered at Kronstadt, but with the Ermak in the Baltic, it could be put to sea as she could easily guide them to open water; indeed, there is nothing to prevent the Ermak from being made into an armed cruiser.

THE PAPER FOR THE WORKINGMAN.

Elmer Burlingame, of Peru, Ind., in renewing his subscription, says:

"You have the right paper and you handle it in the right way for the workingman."

Popular Mechanics, as you have noticed, is improving all the time and you are sure to find the five-year subscription a good investment.



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The Alabama at Full Speed

The Alabama's Splendid Gun Record

Accuracy of Aim Almost Perfect as Demonstrated by the Skilled Gunners

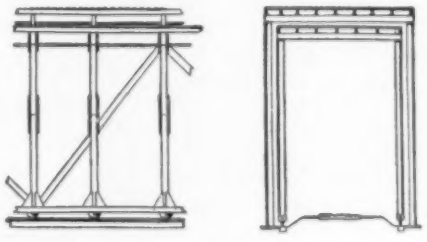
The record in target practice recently made by the warship Alabama, is one that any ship in the navy might be proud of. The Alabama has an armament of four 13-inch guns in turrets, fourteen 6-inch, sixteen 6-pounders, six 1-pounders and four machine guns. With a 13-inch gun, two hits were made on a target in two minutes. Gunner Bright with No. 4 gun in the after turret made four hits in two minutes and 8 seconds—this while the target was 1,600 yards away and while the ship was steaming at the rate of 8 knots an hour.

Seamen Allen and Fletcher on No. 3 gun scored 1.14 hits per minute, the highest average to date for any guns. Of 16 shots all hit the target but one, and that hit the floating frame on which the target rested. The target was a rectangle canvas 21 feet wide by 17 feet high. This miss, fired at a battleship, would have struck the vessel just on the water line, a most vulnerable place. The percentage of hits with the big guns was 93.75.

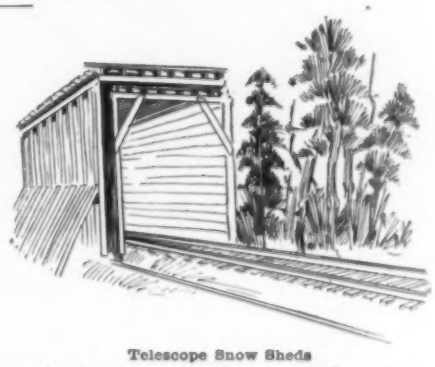
The result of all this rapid accurate work in actual warfare would be something tremendous. It has been proved that the Alabama's 13-inch gun can be fired so that each gun makes 1.14 hits per minute. They throw 1,100 pound projectiles and if the four guns were brought to bear on the same point, 4,400 pounds of steel projectiles loaded with high power explosives could be hurled in 1¼ minutes. The shell for the 6-inch guns weighs 100 pounds. The Alabama carries fourteen 6-inch guns, seven on a side. Of course but seven can be fired at the same object, but if the best average of the gunners were kept up, 45.85 shots could be fired, with accurate aim, hurling 4,585 pounds of shell through the air each minute. Eight of the sixteen 6-pounders can be trained on the same target, so with the record of 10.59 hits a minute with the eight guns, 84.75 shots would be falling on the enemy's vessel a minute. Meantime the 1-pounders and machine guns would add their steel hail to the storm. That is the way the naval experts reckon it, and they claim that with such accurate shooting three minutes would be sufficient to put a quietus to any hostile vessel afloat.

Snow Sheds on Wheels

On the Sierra Nevada mountains the daily downfall during the long winter accumulates in many places to a depth of 60 feet. The entire mountain division of the Central Pacific road is the scene of a contest lasting the entire year. In the winter it is a fight to keep the line from being blocked with snow; during the summer the snow brigades are constantly on the alert to prevent the wooden snow sheds from burning up, as there are miles upon miles of these sheds, representing hundreds of thousands of dollars, their preservation becomes an important matter to the railroad company. To lessen the exposure to fire and to make the distance through which passengers must ride in darkness as short as possible the company's engineers conceived the idea of building the sheds on the principal of a telescope. This is accomplished by placing sections of sheds, 50 feet long, on wheels which rest upon a single rail track, one under each side of the rail. When summer comes the sections are run together



Side and End Views



Telescope Snow Sheds

and several housed under one section. A thousand feet of sheds are thus reduced to 200 or 250 feet. Even with this precaution, and the further effort to throw the exhaust to one side instead of straight up, fires are of daily occurrence, and fire trains must be in readiness day and night. These trains consist of locomotive, a car equipped with powerful fire pumps, and several tank cars filled with water. Powerful blocks and tackle are carried with which to pull down the sheds if the water gives out and the fire cannot be controlled in any other way. Four of these fire trains are in constant service and when a call is sent in these trains are given right of way over all others. The Railroad Gazette says: "In spite of all these precautions a fire will sometimes get under way and, fanned by the fierce winds which blow out of the canyons, will destroy some miles of sheds before it can be checked."

Early Homes of Mormons

Buildings With Many Apartments Each of Which Was Occupied by a Wife

The original typical Mormon home consisted of a one-story building with numerous apartments all adjoining with a long wide porch extending across the entire front. The homes were generally built of stone or brick. Each apartment consisted of two rooms and was occupied by one wife. The building shown in the illustration, is known as "The Rookery," and illustrates a typical Mormon home of the original type. "The Rookery," yet stands in Salt Lake City on East Brigham street. It is composed of ten two-room houses joined in one and was

"THE ROOKERY," WHERE A MORMON LIVED WITH HIS TEN WIVES.

the home of a Mormon with ten wives. The wives all lived contentedly together and the entire colony was frugal and peaceful. There were few crimes ever committed. Drunkenness, theft and frauds were unknown to them and the colony thrived and grew with remarkable rapidity. Their settlement was in the midst of the desert, which land they sought in the hope that their isolation would permit them to follow their religion and creed uninterruptedly. Brigham Young has been called the first irrigator in America. The Mormons by early irrigation of the land made the desert bloom. Their land, previously regarded as uninhabitable, was soon spotted with green fields and prosperous homes. In time it became one of the prettiest countries in the world and then other people flocked there and at once made efforts to drive the Mormons out or compel them to abandon their detested religious practices. The doctrine of polygamy was the most objectionable to these new comers to the land of the Mormons and by a legislative act this was made illegal. The Mormons are now considering the advisability of going into the desert of New Mexico, or some other such land, where they will strive to establish a colony where they may yet be permitted to live and worship according to their own belief. The doctrine of polygamy, is so repulsive to Americans, however, that there is little chance of the sect escaping interference, notwithstanding the constitution's guarantee of freedom of religious worship to inhabitants of the country.

An important institution of the Mormon home, as established by Brigham Young, was the "scrap room." This was equipped with barred windows and was where angry wives were required to assemble to settle their controversies when disputes arose between them. Mormon children do not call all the husband's wives by the title of "mother." Brigham Young established the custom that, to the children of one wife, all the other wives of the father should be known as "aunt." All the children of all the wives, however, call each other brother and sister.

In the Harems of Europe and Asia where one husband often has a multitude of wives, it is the general rule that mothers-in-law are not permitted to speak to the wives, except by signs. These signs, between mother-in-law and daughter-in-law, however, are often more effective than words and not infrequently result in "unpleasant feelings."

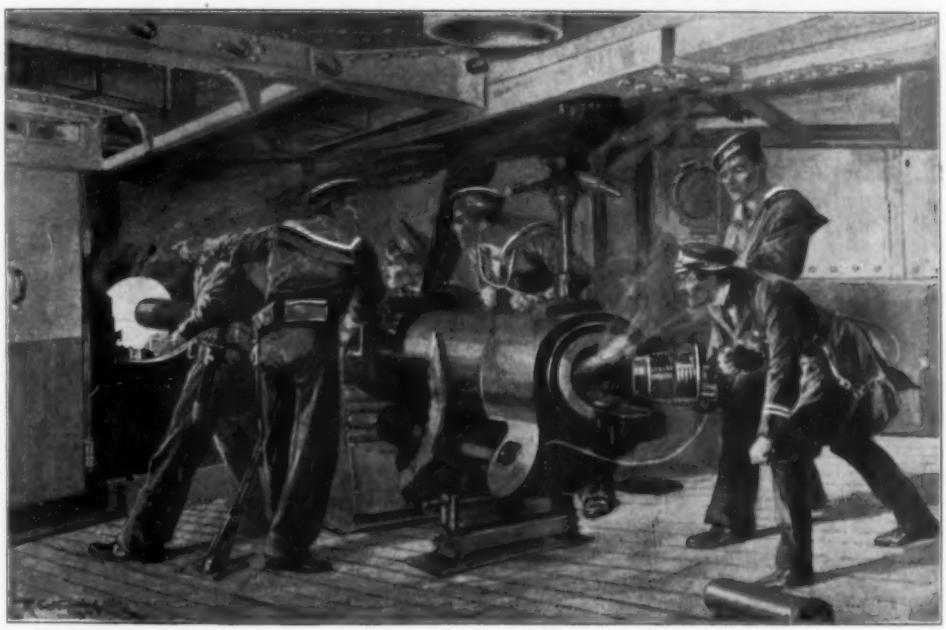
Russia's Herculean Task in the Far East

How Her Success or Failure Depends on One Long Single Track Railroad

By Guillo Grey

Renewed activity in the far East, manifested during the last days of March, leads to the belief that the Japanese-Russian war is now beginning in earnest. The breaking up of the ice in the northern waters permits of better operation in the fleets of both nations and both sides are rejoicing that the severe Russian winter is nearing an end. Lake Baikal, however, will be frozen solid until the end of May, but when the ice does begin to thaw the problem of transportation across the obstructive body of water will be considerably lessened. At present the lake is crossed by means of horse-cars and sleighs. When the ice is thinner Russia's powerful ice-breakers will be put to work and the troops, horses and provisions will be transported across the lake by means of ferries.

In the struggle, the far-reaching consequences of which are difficult to predict, every advantage sems to lie with Japan. The Mikado's country has by far the superior navy; she is ideally situated relative to the scene of hostilities, being near and possessing excellent facilities for the handling of troops and provisions. Japan, being warm, can grow provisions for feeding the Japanese army, while Russia is still covered with ice. There are hundreds of sources through which provisions may be sent to Japan from all parts of the world and easily conveyed from Japan to the soldiers and sailors at the front. Port Arthur, Manchuria and Korea are virtually at Japan's door, and provisioning the army and navy is a secondary question for the Flowery Kingdom. The Japanese from the proximity and from the late war with China are familiar with every mile of the territory



The First Shot--Scene on Board a Japanese Battleship at the Port Arthur Battle

in which the war is being waged. Then Japan has all the advantage of the lengthy preparations she had made for the struggle, during which her navy was put in spick-and-span condition; her army drilled and equipped; her larder filled to overflowing; her friendship with other nations strengthened, and her plan of campaign carefully mapped out.

Not one of these advantages can be claimed for Russia, and this is why army experts predict defeat for Russian arms. The Russian navy is now remarkably inferior, damaged by Japanese attacks and divided. Russia had made inadequate preparations for the war and was taken completely by surprise. Her navy was unprepared and scattered; her army, far removed, unrecruited, poorly drilled, divided and unprovisioned. While to the Japanese it will be like fighting on their own soil, to the Russians the field of action, although Russian territory, is like a foreign country separated by thousands of miles of land and water. One single-track, newly constructed railway, poorly equipped, is the sole dependence of the mighty Russian empire, covering one-sixth the territorial surface of the globe, to send its troops to the seat of war, 4,000 miles removed from the home base, and to feed them after they are there. Never was the importance of a railway in war more clearly set forth than in this Trans-Siberian line at present; never was more dependence placed in a railway than in this. If the Trans-Siberian line fails Russia, all is lost to her. Her vast army, her ships, her rough-riders avail nothing then. Withal, never was a road more beset with obstacles, varied disadvantages and more ill-fitted for the herculean task it is called on to perform. Dangers by ice, snow, robbers, dynamite and new construction threaten the entire 4,000 miles of its length. In this 4,000 miles of distance there are 100 miles of bridges to cross, the destruction of any one of which would mean disaster to Russia. That is why Russia now employs an army of 50,000 men to guard this railway alone; that is why any person walking on or touching the railroad away from the stations is shot without question or ceremony.

Away to the Far-off Front--Russian Soldiers Traveling by the Trans-Siberian Railway

There are now said to be 200,000 Russian troops in Manchuria and tacticians declare that a single line of railway can only supply an army of half this size. Japan is seemingly in position to cut off Russian sup-

plies sent from any part of the world by any other route than the Trans-Siberian railway.

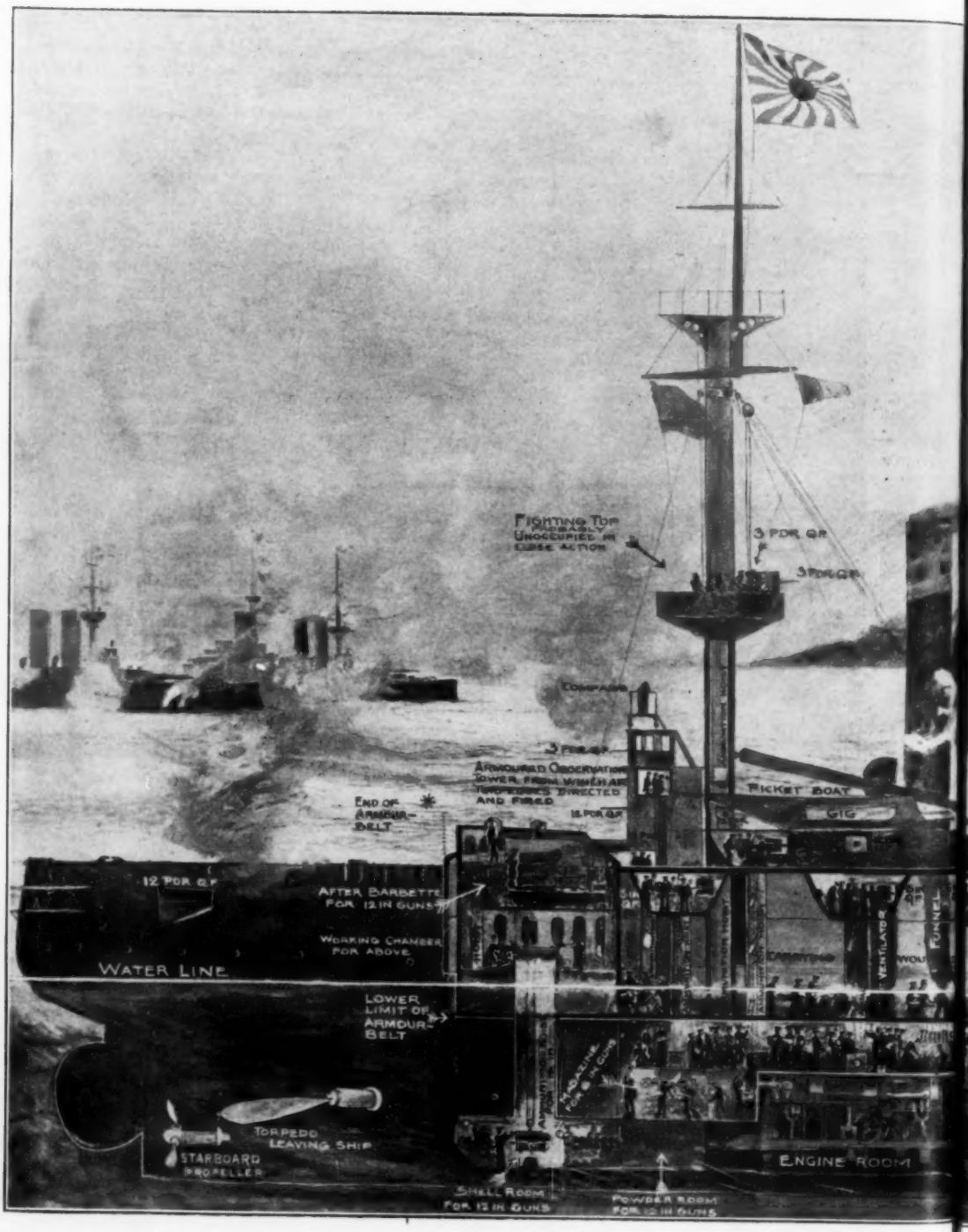
On the Trans-Siberian railway, through an extraordinary effort, seven trains are being dispatched every day. This is the limit of the road's capacity. The transport of an army corps numbering 25,000 men with 144 guns requires 112 trains and requires 16 days to load. Manchuria is not a food-producing country, cattle are scarce and oats are grown solely in the northern part near Harbin and then not in any great quantity. There are but four flour mills at Harbin and they are now taken over by the troops. The natives are most unfriendly and will not bring in supplies; hay, required for the artillery horses, which are imported from Russia, is most difficult to procure. Port Arthur is deemed in a sore plight, for the Japanese will undoubtedly capture all the provisions being sent there by water, unless the Japanese fleet is speedily driven away, and that is exceedingly improbable.

After Russian supplies have reached the field of action over the single line road, the trouble is yet not ended. Transporting the supplies from the train to the army depots is another problem. The Russians transport their stores in two horse carts with two wheels and the horsing of these carts will constitute a great difficulty. Doubtless they and the Japanese will use the mule of the country for transport purposes. The feeding and horsing of the field batteries will give the Russians the most trouble.

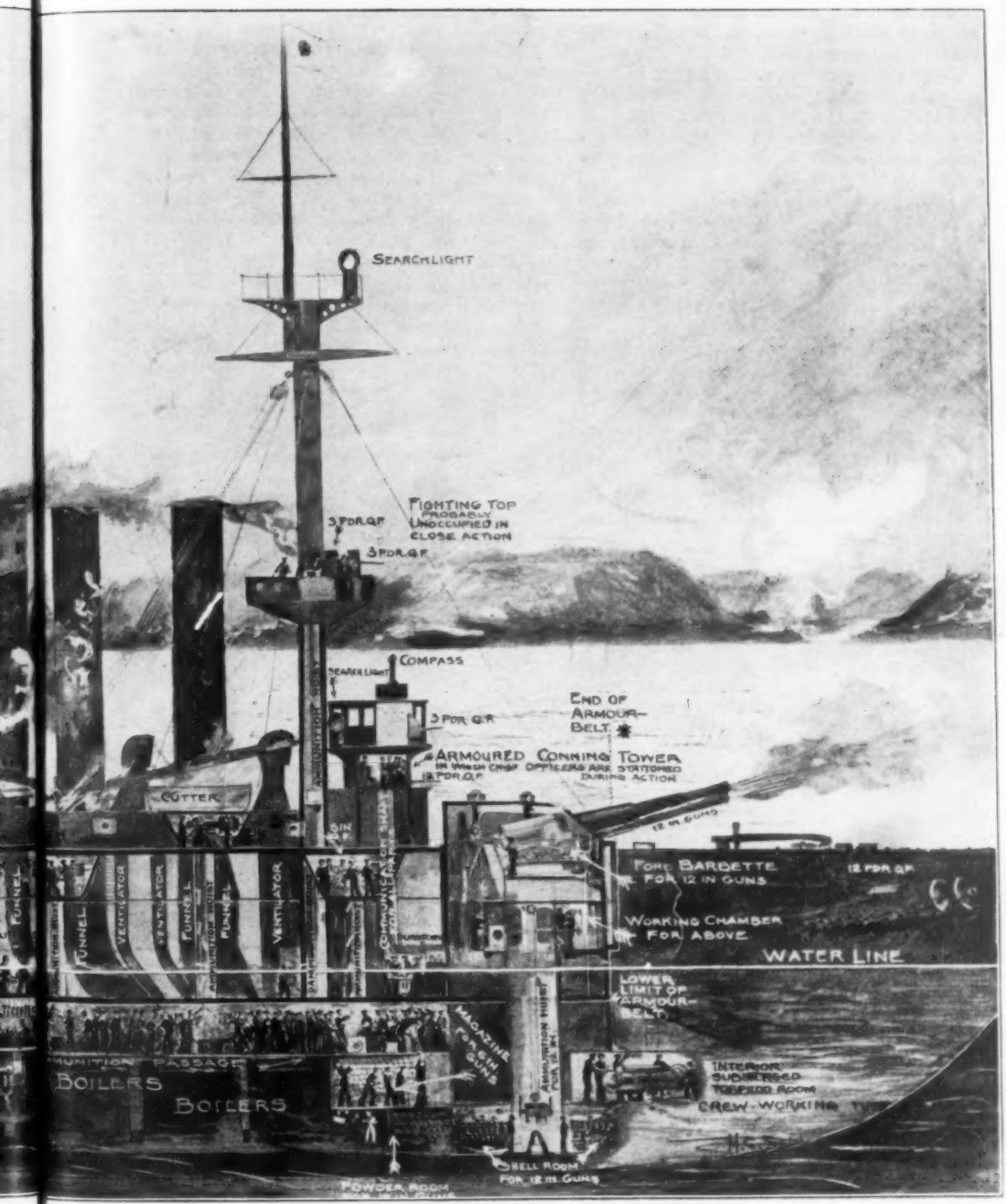
Cossacks Guarding the Sungari Bridge of the Trans-Siberian Railroad

In contrast with the meat-and-bread-eating Russian, the Japanese has his ration—rice and dried fruits, roots and fish—which enables him to get considerable assistance from the country in which he is fighting, the Manchurian and Corean eating almost the same food, so that for the majority of his supplies he will not have to fall back on his base in Japan, but can collect from the friendly native.

The system of transporting supplies from Japan is most perfect. All supplies are done up in packages, covered with matting, of a size that can be easily lifted by two men. There is, therefore, no waste and the difficulty of transit is reduced to a minimum. These packages are put on steamers, then transferred to smaller tugs, of which the Japs have plenty and the Russians none; then from the tugs to the small boats, where again the Japanese surpasses the Russian, as he is a born boatsman. For this reason the Japs seized the waterway to Tientsin in 1900, whereas the Russians seized the railway; and it is beyond doubt that the Japanese will use the waterway from Newchwang to Mukden as a means of transport



Interior of a **Jap**



Japanese Battleship.

during this, as well as in the China-Japan war. The Japs, on the other hand, having command of the sea, bring their wood from Japan in small bundles, as they did in the time of Boxer troubles.

From the shore, on which, owing to their draught steamers and small boats, they can land with facility at many points, their supplies are transported to bases in light carts, most adaptable to the country they will have to fight in. These vehicles are in strong contrast to the heavy Russian cart. The Russians have no corps of transport men, save the Cossack, whereas the Japanese troops may confine their duties to fighting, for they bring their own corps of coolies—strong, well-built men, capable of doing the best of work.

The Trans-Siberian railway, on which Russia depends for success or failure in the present war, is in construction and equipment similar to the railway lines in the western United States about 20 years ago. The rails are light and old-style engines, as the illustrations show, are employed to haul the trains. Among the greatest of the many obstacles Russia has to contend with in transportation over the line is Lake Baikal, the Chunchuses or Chinese bandits, and Japanese interference. Once traffic on the line is intercepted, either by the wreck of a train by bandits, the blowing up of bridges by the Japanese, or other cause, the source of supply for the Russian army is cut off, and it would seem that nothing but surrender awaits the Czar's forces. Lake Baikal is 1,500 feet above sea level, is 4,000 feet deep and covers an area of more than 13,000 square miles. It is larger than any lake in the United States, excepting Lake Superior. The field ice on the lake forms 36 feet deep. From 20 to 50 miles wide, 500 miles long and set among hills rising from 3,000 to 4,000 feet above the lake's surface, this body of water is proving a sore menace to Russia in the present crisis. The ice with which it is covered for six months in the year is constantly cracking from sudden falls in temperature and men and horses frequently fall through the cracks. A connecting line is being built through the hills around the southern end of the lake, but this will not be completed before 1905. In the meantime Russia is compelled to get her supplies across the best way she can. A railroad has been built across the ice as a means of facilitating the movement of troops and supplies, and engines were used to haul the cars until one of the locomotives a short time ago broke through the ice and disappeared. Since then the cars are pulled by horses. The rail route across the lake is 42 miles long.

There are two great ice-breakers on Lake Baikal, both of which will be put in operation as soon as the ice begins to thaw. One is the Baikal, the largest ice-breaking railway ferry-steamer in the world, and the other the Angara, which conveys passengers only. The Baikal is 290 feet long and of 4,200 tons' displacement. Her draught under ordinary working condition is about 19 feet. She has three sets of triple expansion engines, one at the bow, and two screws at the stern. The principle of subdivision is carried out in the highest degree and a large number of compartments would have to be pierced before she would sink. The vessel has luxurious accommodations and a promenade deck for the use of passengers. The vessel has three lines of rails, entered from the forward end; the entire track is very strong to carry the locomotives, which on this railway, loaded with tender, weigh from 94 to 104 tons.

The Baikal's consort, the Angara, is a fine ice-breaker, having one screw of 1,500 i. h. p. triple expansion engines and locoboilers. These boilers were adopted so as to get over the difficulties of transshipment from St. Petersburg to Lake Baikal. The Angara makes her passage with the utmost regularity with mails and passengers.

About 500 tunnels and bridges are necessary in building the railway around Lake Baikal, and as the valleys are very steep and work can only be carried on during the open months, the engineering difficulties are apparent. No other section encountered in the construction of the entire line was nearly so difficult as this. On the lake is the only present interruption on the line. The western section which extends from Cheliabinsk, on the European frontier, to Pochitanka, 1,080 miles, runs for 880 miles over a plateau so level that the distance exceeds an air line by only 2½ per cent. There is a tunnel on the trans-Baikal section which was an open cut, roofed with a stone arch to save the roadbed from landslides. There are snowsheds and fences to the extent of 565 miles. The trains make fairly good time with the exception of the stops which are excessively long, being of from one to six hours' duration.

The cost of the system up to the present time has been more than $200,000,000. The building of the line around Lake Baikal and

the regrading and relaying of a large portion of the roadbed will add a large amount to this.

For a troop train to make the trip from Warsaw to Manchuria requires about 30 days. Each troop train is provided with a restaurant car and the men's meals are cooked at the various halting places where barrack accommodations of a rough sort are usually provided. It is estimated that only about 5,000 troops per week can be transferred from Russia proper by means of the railway, as the number of sidings, especially at the eastern end of the line, is very limited. The danger to the high-pitched embankments from trains laden with heavy artillery must not be overlooked.

That the permanent way of the railway will prove equal to the strain of the constant traffic demanded of it during the next few months is more than doubtful. M. DeWitte, who inspected the eastern portion of the line last summer, found that it had been very badly laid in many places, light rails having been substituted for the heavier ones contracted for. He was accompanied on his trip by Chief Engineer Alexis Yogorivich, who built the main portion of this line, and it was found that the Russian contractors had scamped their work in many respects. The rails for a great portion of the road were made in the United States.

Lake Baikal being crossed, the next serious danger the troop trains must guard against is that of the destruction of the track by the "Chunchuses," or Chinese bandits, and by the Japanese spies. For months past the spies have infested the eastern portion of the line in every possible disguise and are sure to attempt to destroy any weakly guarded bridge. The railway crosses several large rivers and also several smaller tributaries of the Amur and Sungari, and when once one of these large bridges has been destroyed, it will be weeks before repairs can be made and traffic resumed.

The Novoe Vreyma, Russia's leading newspaper, reports the Chunchuses have lately been exceedingly active in their attacks on several of the smaller posts and bridges in southern Manchuria, more especially that portion of the line which extends from Harbin to Port Arthur—in all a distance of about 700 miles. These bandits are reported to be 200,000 strong. They have an abundance of small arms and ammunition. They consist principally of disbanded soldiers of the Chinese army who have been drilled by foreigners. They are as good shots as the Siberian Cossack and their shooting is their living. The robbers have a well organized system and their profession has proven most lucrative. They are in a way honest, for they give passes

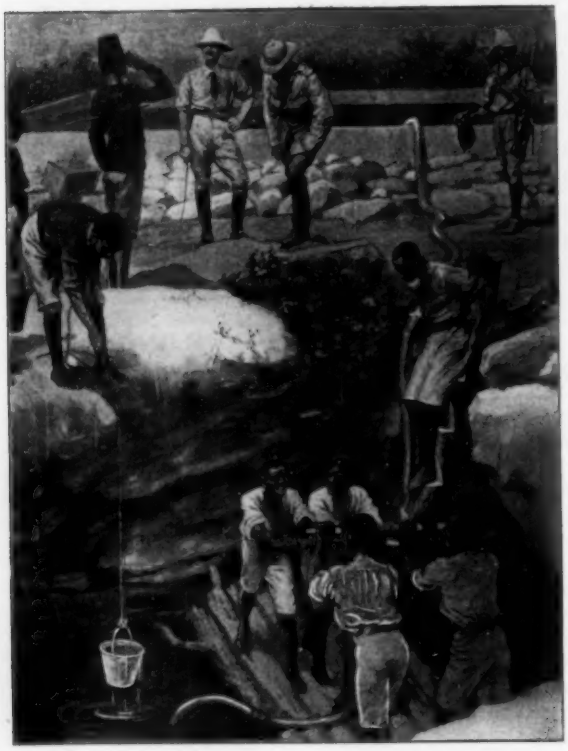
Building the Railaway Over the Ice Across Lake Baikal

to the villagers who bring their produce to Newchwang, both by water and roadways. Carts and boats holding passes from these robbers carry the flag of the band that issued the passes, and strange to relate, these passes are always respected by the members of other bands. So that once having paid his toll to the robber, the villager goes on his way rejoicing, well knowing that he has nothing more to fear. The Japanese when they took possession of the country following the Chino-Japanese war, seeing that they could not cope with the bandit, allowed him to carry on a trade which kept the country settled to the satisfaction of both villager and bandit, and did not interfere with their trade, as if they regarded it legitimate. The higher Russian authorities, since the Russians took possession of Manchuria, have endeavored to put down the robbers, but the lower officers have only opposed the robbers when they failed to meet their demands, which has often led to trouble.

It was the bandits who destroyed the Trans-Siberian railroad between Mukden and Port Arthur during the Boxer trouble, carrying away rails and sleepers for miles, cutting the iron bridges into small pieces—a feat one would think impossible, but they get the villagers to help them and work like ants. Not only pickets along the entire line, but strong bodies of troops at close intervals are required to protect the Trans-Siberian road from these bandits, for they are daring to a degree and have past grievances with the Russians to settle. The Chinese have sent Yuanshe-Kai and his army corps to the great wall at Shan-hai-kwan to keep these robbers from infesting China, if driven out by the Russian troops. The robbers and the natives both hate Russia and are friendly to Japan.

With these numerous obstacles to encounter it is plain to see that Russia is unlikely to defeat Japan unless her soldier is by nature a superior individual and fighter to the Japanese.

Bad Water Balks the British



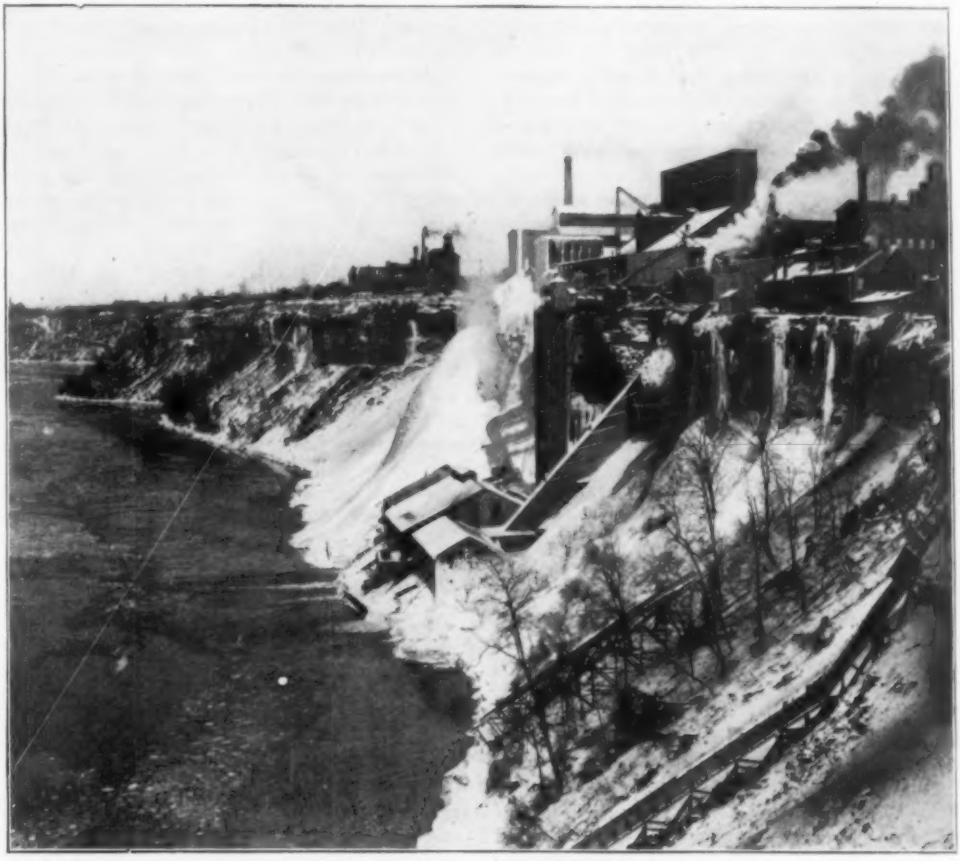
Purifying Water in the Nogal Valley—Somalliland

Ill-tasting water has proven one of the most formidable obstacles the British soldiers have experienced in their invasion of Somalliland. So maladorous and repulsive to the taste is the water that it must be distilled before it can be drunk. The illustration shows how the natives of Somalliland are forced to pump the watef from the natural springs into tanks for the convenience of the English campaigners. The scene is in Nogal Valley—the Stony Country. Here the wells are principally caves in gypsum rock. The water in them is impregnated with sulphuretted hydrogen. Natives however, drink the water with relish and without any apparent ill effect.

The British soldiers have devised a method of "aerating" the water to make it palatable. A large sail cloth tank is erected on the brink of a well and into the tank the water is pumped. After exposure to the sun and air the unpleasant smell and taste disappears and after the water has been further treated by a cooling process, the soldiers are enabled to drink it.

Icicles at Niagara Weighing Hundreds of Tons

Icicles weighing hundreds of tons each, and great blocks of solid ice as large as hills, threaten to fall and carry away valuable property at Niagara Falls. Thousands of tons of water, which formerly passed over the falls, have been diverted and now are conducted through great canals to a point below the falls for power purposes. As the water emerges from the turbine wheels it flows into the torrent below, but the past winter has been so severe that even this dashing flood has been caught and held in the grasp of the ice king. Constantly increasing in size by day and night, there has accumulated thousands of tons of ice, which now threatens to break away from its position and falling 150 feet, destroy the power plants below and carry the wreck into the foaming torrent. Another danger is also imminent, the ice mass may carry with it great portions of the cliff itself. Dynamite has been suggested as a means of detaching the ice.



Ice Dangers to Power Plants at Niagara Falls

WASHING BY THE POUND.

A laundry in Utica, N. Y., which does washing by the pound has issued a card stating its rates. Finished washing is done at ten cents per pound for 10-pound or more washings. This excludes dresses, shirt waists, shirts, collars and cuffs and allows but one skirt to each dozen pieces.

Rough dry washing costs but five cents per pound. Everything that ought to be starched is starched and all flat work such as sheets, slips, napkins, etc., are ironed.

This enables families to send their entire washing, as the rates are much lower than home labor could afford.

Japanese at Last Our Friends

Formerly Insulted the United States Flag and Shed American Blood--How They Were Punished

By Paul Orr

America is indebted to England for the friendly relations now existing between this country and Japan. Prior to England's effective good offices, Japan killed our sailors, fired on our flag, repulsed our merchant steamers, burned the American consulate, detained shipwrecked American seamen, renounced treaties with us, and on July 16, 1863, a naval battle was fought between this country and Japan, resulting in a victory for the United States. As a result of this battle Japan was forced to pay $750,000 indemnity.

In the battle four sailors and a marine of the United States ship Wyoming were killed, many Americans were wounded, and 100 Japanese were killed. The battle was in the straits of Shimonoseki and the little boat Wyoming was pitted against three Japanese ships and several land batteries, but it was Americans the Japanese were fighting then, and the American victory was complete.

The cause of the battle was the action of the Japanese, a short time before, in firing on the defenseless American steamer Pembroke. The Pembroke, freighted with merchandise, bound from Yokohama to Nagasaki, was nearing the eastern entrance of the Shimonoseki straits, with the American flag flying. The powerful batteries of the forts and the war vessels opened fire on her and she was compelled to put out to sea again. The United States Minister, Pruin, under orders from Washington, at once sent the Wyoming to the scene of the attack, to demand an explanation for this latest Japanese insult to the American flag. The Wyoming was in command of Commander David Stockton McDougal, who died a rear-admiral. When he entered the straits he had the port holes of the Wyoming covered with tarpaulin so that she looked like a merchant vessel. Two square-rigged vessels and a steamer could be seen in the narrow entrance to the straits.

"Gentlemen, we will either blow those ships out of the water or sink ourselves," said McDougal to his officers. He noticed that the center of the channel was marked by a stake. He suspected that the guns of the fort were trained on this point and so gave orders to run in close to the northern shore. It was this foresight that saved the Wyoming from utter destruction at the hands of the Japanese. The American flag was run up and the little Wyoming made for the first ship inside. The Wyoming carried only six guns, while the combined armament of the Japanese ships and forts amounted to 48 guns. The Lanrick, one of the Japanese vessels, poured three broadsides into the Wyoming. The American vessel replied with such vigor that the Lanrick was soon in a sinking condition. As the Lanrick went down, the Daniel Webster, an American built Japanese vessel, opened up on the Wyoming with the same result. The two Japanese vessels being sunk, the third, the Lancefield, tried to escape. The Wyoming gave her chase and after a few well directed shots she was blown up. Commander McDougal then turned his attention to the forts, silencing them. While the Wyoming destroyed three vessels, killed more than 100 Japanese and silenced all the forts, only five of the Americans were killed, but quite a number were wounded. The hull of the Wyoming was hit ten times, her funnel had six holes in it, two masts were injured and the upper rigging was badly cut.

As early as 1831 the United States in an effort to regain the friendship of Japan returned to her coast a number of shipwrecked Japanese sailors. Upon the arrival of the American ship Morrison, containing the Japanese sailors, the Japanese misconstrued our intentions and fired on the ship and repelled her with violence. The American ships Columbus and Vincennes were sent to Japan to demand a hearing. The Japanese then condescended to listen to our petition for a commercial treaty, but steadfastly refused to enter into any friendly relations with us whatsoever and the American ships returned disappointed in their mission.

In 1849 some American seamen were shipwrecked on the Japanese coast, and instead of returning them to the United States as the Americans had returned the shipwrecked Japanese seamen, the Japanese took the Americans in custody and would not even permit them to be returned to American shores. It was necessary for the United States to send the sloop Preble,

Capt. Glynn, to secure the release of the American seamen.

In 1854 the United States, through Commodore Perry, finally succeeded in obtaining a treaty with Japan, according to which the ports of Simoda and Hokodadi were opened to the United States. In 1857 Mr. Harris, consul-general of the United States, made a new treaty opening the port of Nagasaki. These treaties were repeatedly violated, however, and caused great antagonism.

Several years after that Japanese hostility toward the United States assumed more threatening proportions and finally the United States legation was burned. Next followed the action of the Japanese in firing on the American steamer Pembroke while flying the American flag, and the battle between the three Japanese ships, the Japanese forts and the Wyoming.

Elevator Fire Escape and Stand Pipe

A fire escape and stand pipe which does away with the climbing of ladders and the carrying of hose; which can be operated easily and afford an absolutely safe escape for persons in the highest stories of burning buildings seems scarcely reasonable even in our day of high attainments. Yet such a fire escape has been invented by Israel Hogeland, of Indianapolis, Ind.

Fire Escape in Use

By means of compressed air this escape can lift or lower in 30 seconds, to a height of sixty or seventy feet, a fireman and five lines of hose. At the top is an extension gangway over which people in the building can walk to the carriage of the hoist and be safely lowered to the ground. The invention comes at an opportune time and will probably receive the attention of fire departments in all large cities.

FEARS COLLAPSE OF BOSTON'S SKY-SCRAPERS.

Danger of collapse of skyscrapers from corrosion, formerly related in Popular Mechanics, is corroborated by Prof. Charles L. Norton, of the Massachusetts Institute of Technology, who declares that every skyscraper in Boston is in danger of collapse.

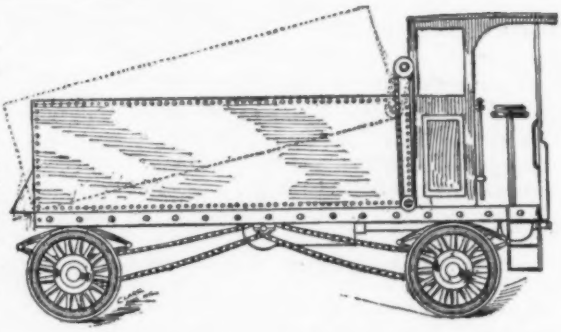
Prof. Norton says that the corrosion of steel and the consequent weakening of the structures, because of the ineffectiveness of some of the preparations used to protect the metal, should be carefully considered by builders. He condemns stone work and terra cotta as being ineffective against fire and says concrete is by far the best protector for structural material against flames.

SINKING ROCK FOR A TUNNEL

Sinking large blocks of cement that a tunnel may be bored through them is a curious feature in the construction of the extension lines of the Metropolitan Railway in Paris. Three railway lines to cross at different levels at one place, the subsoil near the surface containing water, occasioned the problem that was solved in this uniquie manner.

Freight Trucks That Climb Hills

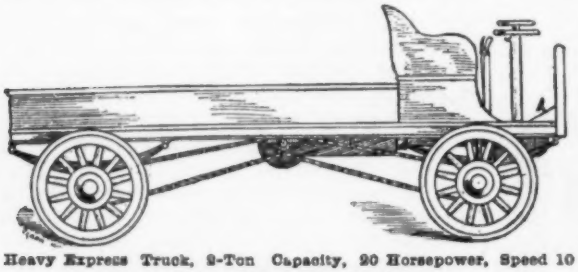
The motor freight truck is rapidly displacing the horse and mule for hauling heavy loads in our larger cities. The very large saving over animal power insures the general adoption of the mechanical power. As teaming is more costly in the larger cities, it is here the change is first being made, but in time it is bound to include smaller cities and towns. It is a question of dollars, and in the comparison the motor truck is an easy victor.



Coal Truck, 7-Ton Capacity, 50 Horsepower—Speed 6 Miles An Hour When Loaded

The use of motor trucks has been confined chiefly to level and well paved streets, but their field of usefulness is to be greatly enlarged. A recent invention enables the use of each of the four wheels of the trucks as driving wheels, instead of only the two rear wheels. By this means the heavier the load the greater the tractive power of the truck, and the easier it can climb a hill. The large coal truck has a four-cylinder 50-horsepower gasoline engine which is placed at the front end, under the foot board and is readily accessible. The engine cylinders are arranged in directly opposed pairs. The impulses are so timed as to give an explosion at every stroke of the crank. This reduces the vibration caused by the explosions and reciprocating parts to a minimum. The clutch for engaging and disengaging the engine from the driving mechanism is placed in the fly wheel and is operated by a ratchet foot pedal. The drive shaft extends back through the transmission gear with bevel gear drive to a spur gear differential.

Three forward speeds and reverses are obtained by a sliding gear transmission. The ratio between engine and drive wheels on the (direct) high speed is 12 to 1; on the second speed is 24 to 1, and the slow speed and reverse is 48 to 1. The direct drive speed is six miles per hour loaded, and by speeding up the engine when empty a speed of eight miles can be obtained.



Heavy Express Truck, 2-Ton Capacity, 20 Horsepower, Speed 10 Miles an Hour When Loaded

The truck weighs 7,000 pounds and is 17 feet long by 7 feet 8 inches wide. The wagon box can be raised at one end to dump the load.

RUSSIAN RULES FOR HELP IN CASE OF ELECTRIC SHOCKS.

Russian electrical engineers have a most efficient code of rules for rendering aid in case of electric shock. Among other requirements are those for a life-saving room in every power station, this room to be equipped with all the articles and instruments necessary to its purpose, and to be accessible to every person apt to be called on for aid; rubber gloves and overshoes, subjected to powerful tests every six months, must be provided for the protection of the rescuer, whose work of separating persons from contact with live wires is dangerous. In remote cases it is recommended that dry cordage or clothing, soaked with salt water, be thrown over the wires for insulation.

These rules are placed conspicuously in all stations and have diagrams showing how to proceed in various emergencies.

Lady—"Why did you leave your last place?"

Cook—"I couldn't stand the dreadful noise between the master and missus, mum."

Lady—"What was the noise about?"

Cook—"The way the dinner was cooked, mum."

How To Do Your Own Wall Papering

Easy and Attractive Work Performed with Little Inconvenience

Fig. 1. Folding the Paper

Do not employ a man to hang your wall paper. Do it yourself. The work is easy—much easier and more attractive than laying carpets—and from the additional interest you will take in it, the prospects are that the job will be better done. To the person who is neat and possesses artistic inclinations, there is a splendid opportunity for exertions to produce tidy and pleasing effects, and nothing adds more to the appearance of a room than well dressed walls.

Select your own wall paper of a design and color best suited to the lighting and adaptations of the room. You should make careful measurements of the room before purchasing the paper.

Fig. 2. Cutting the Paper

Measure the width, length and height of the room which you intend to paper. By taking the entire distance around the room, which is obtained by adding the width of the four sides together, and multiplying this by the height of the room, you will obtain the number of square feet of wall surface. You will then allow 20 square feet for each door and window. Subtract the total number of square feet of all the doors and windows from the total number of square feet of the entire wall surface of the room, and this will give you the square feet of surface to cover with wall paper. By dividing this by 60, which is the approximate capacity of a double roll of paper, you will obtain the number of double rolls required for the side walls. To find the number of rolls required for the ceiling, multiply the width of the room by the length of the room, which will give you the number of square feet in the ceiling, and by dividing this by 60, you will find the number of double rolls of ceiling paper required.

Suppose a room to be 12 feet wide by 13 feet long by 10 feet high. The total distance around the room is the total width of the four sides, as follows: 12 plus 12 plus 13 plus 13, equaling 50 feet. This multiplied by 10, the height, gives you 5000 feet of wall surface. Suppose there are two doors and two windows. Allowing for each 20 square feet, gives 80 square feet of space taken up by windows and doors. Subtracting the 80 square feet from the 500 square feet leaves 420 square feet of wall surface to be covered with paper. Dividing the 420 square feet by 60 gives you 7, the number of double rolls of side wall paper required.

For the ceiling you will multiply the width, 12 feet, by the length, 13 feet, making a total of 156 square feet. Dividing this by 60 gives you 2½ and in this case, as double rolls are not cut, you would allow 3 double rolls for the ceiling paper. For the border you add together the width of the four sides, 12 plus 12 plus 13 plus 13, equaling 50 feet, gives you, say, 17 yards of border required.

It is well to add an extra roll for each wall and ceiling, and several extra yards of border. You are apt to spoil a strip, occasionally, and when figuring you may overlook projections, such as chimneys, etc. Often an extra roll, worth a few cents, will save great inconvenience.

Before commencing you should secure all the necessary articles needed for your work. To apply the paste you will require a paste brush from 6 to 10 inches wide—a whitewash or kalsomine brush will answer. Get a long pair of shears to insure a straight cut to trim the edges. A seam roller is required to press down and smooth the edges where each strip of paper laps over or is joined together. If you have no seam roller a bed caster will do. Be careful not to use the seam roller until your paste on the paper that is hung is partially dry. A regular paper hanger's trimmer can be purchased for a small amount but scissors will answer the purpose nearly as well. Paper hanger's knives, wheel knives, base trimmers, folding pasting table, past-

ing board, etc., add to the convenience of papering a wall, but other tools can be easily substituted.

To make your table on which to cut the paper, secure two boards about 8 feet long and 10 or 12 inches wide; lay them side by side, permitting the ends to rest on a table or box at each end. The table or box should not be more than three feet high. Now secure some planks for the platform on which to stand while papering. This can be made by placing the planks on ordinary boxes or chairs. The platform should be nearly as long as the width of the room, and so high that your head will be about six inches from the ceiling.

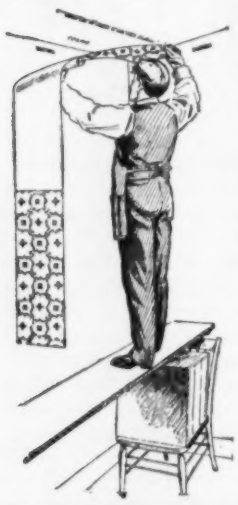


Fig. 3. Papering the Ceiling

A dry paste for use with cold water, can be bought in the form of a perfectly pure powder, and is prepared for use instantly by simply stirring it into cold water. It dissolves immediately and you can make as much or as little as you need in a moment. It keeps for a long time after being mixed. One pound of powder makes ten pounds of paste ready for use, and you can make it thick or thin as the purpose requires. But it is easy to make your own paste, entirely. To make a sufficient amount to paper a good sized room, take 3 pints of flour, rub smooth in two quarts of cold water; add 8 quarts of boiling water and let this boil slowly. Stir constantly for 10 minutes. When cold, stir in two tablespoonfuls of powdered alum. Use the paste about as thick as will run off the brush.

New walls which have never been papered should be gone over with a thin coat of size, which is made by soaking a pound of glue for 12 hours in cold water and adding a tablespoonful of powdered alum. Before sizing, all kalsomine or whitewash should be washed off the walls. If the walls have been rough plastered or have not been putty coated, rub off the projecting grains of sand with a block of wood, and if the walls are very bad, apply thin paste and let it dry before papering. Walls that have been painted should be gone over with a solution consisting of one part ammonia and six parts water, before sizing. Board ceilings or walls should be covered with cheese cloth tacked at the edges and then sized, which shrinks it tight to the wall. The row of tacks at the corners and around the casing should be about two inches from the same and the ends of the cloth pasted down. In cleaning and sizing your walls, be careful to do it thoroughly around the baseboard and casings, and you will have no trouble with your paper curling at the edges.

The bucket of paste should be placed on the right hand side of the operator. Paper your ceiling first, for in doing this you are apt to touch the side walls with paper that has paste on it, or with your soiled hands. As a guide for hanging the first length of ceiling paper, draw a line with chalk 16 inches from the side wall. This is done best by driving a small nail in the ceiling 16 inches from the side wall at each end of the room before starting to paper. Chalk a piece of cord; tie the same to the nails, draw it tight, then take hold of the cord in the center, pull down and let it go; the cord will strike the ceiling and leave a straight line. (See Fig. 3.)

Now apply the paste evenly on the top strip of paper beginning on the left hand end of the tables as you face the same. After you have applied the paste on about one-half of the length, lay aside your brush and fold over the part of paper that is pasted, using extra care that the sides are exactly even (Fig. 1). Now apply the paste to the other half and fold that over toward the center, the same as with the first half. If the strip of paper is longer than your table, paste the left half after folding and allow the folded end to hang over the end of the table and rest on the floor while you are pasting and folding the other half. You now have an entire strip of paper before you, all pasted and folded, and the sides of the paper perfectly even and ready for trimming. Draw the strips of paper towards you about three inches from the edge of the table and proceed to trim, commencing at the right (Fig. 2). The great advantage in trimming paper after pasting is that the paste will then be more evenly distributed on the edges. It also takes less time as you trim two thicknesses at once.

After the selvage is trimmed off, your paper will be 18 inches wide. For the same

reason that the ends of the paper should come down a few inches on the side wall, the first strip put up and also the last strip of ceiling should lap two inches on the side wall.

Take the first piece of ceiling paper, which you have already pasted, folded and trimmed. Mount your raised platform, start in at the right hand corner of the room, unfold the end of paper to your right, let the other end, which is still folded, hang over a roll of paper which you hold in your left hand (Fig. 3). Commence in the corner of the ceiling, having the first strip of paper come between the chalk line and the wall you face, allowing both the end and the side of the paper to come down on the side wall two inches, as previously explained. Now guide your paper with your right hand along the chalk line, at the same time pressing the paper to the ceiling with the flat of your hand as you move along and smoothing the same with brush or whisk broom. When half of

Paper Hangers' Tools.

the first ceiling strip is put on, then unfold the other half and continue to the end of the first strip. When hanging the second length you are guided by the edge of the first strip and so on until the last strip of ceiling is put up. The edge of the last strip should also lap on the side wall. Care must be taken to have your patterns match.

Always hang the side wall paper before hanging the border. Follow the same instructions for cutting the paper for the sidewalls as for the ceiling. The paper should be cut from 4 to 5 inches longer than the length required for the side wall that is to be papered. In cutting your side wall paper you can allow for the space of wall that the border will cover. All borders are either 9 or 18 inches wide.

Be sure to match the pattern, which is very easily done. As you have allowed from 4 to 6 inches in cutting, you can raise or lower each strip or length of paper as the pattern may require. In matching your side wall paper on the work table you will find when a large pattern is selected that there will be at times a waste of 8 or 10 inches which will have to be cut off. The upper end of the side wall paper will be uneven but the border will cover these uneven ends. The lower end which stops at the baseboard, is either trimmed with a base trimmer or a pair of shears. When using shears, paste your paper in place close down to the baseboard; use the back of the shears to mark with, running the same over the top of the paper where the top of the baseboard and the plaster meet; then lift your paper a little—the paste still being fresh will permit of this—and cut where you have marked with shears and smooth down with brush or whisk broom.

Fig. 4. Papering the Side Wall

To hang sidewall paper arrange your platform or step ladder so it is about 12 inches from the wall; commence at any door, as this will be of great assistance to you in hanging the first piece of side wall paper straight; then continue around the room until finished. All short pieces can be used over doors and windows.

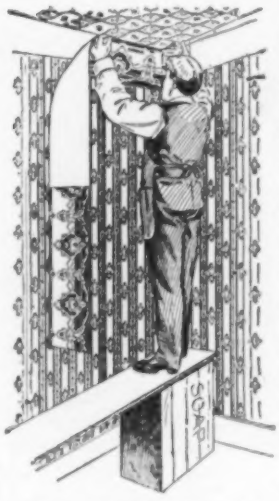


Fig. 5. Hanging the Border

Take your first length of paper that has been pasted, folded and trimmed. Mount the platform or ladder, unfold both ends and the entire strip hangs perpendicular. Holding the strip at both top corners (see

Fig. 4) lean forward, looking down along the edge, and when the pattern is properly matched, allow the paper to touch the wall and smooth down with a brush or whisk broom.

About ten minutes should elapse before using the seam roller, as the paste is still wet and will squeeze out at the edges. Occasionally it will happen that a strip is not properly matched after being hung. In such a case remove the strip at once and proceed over again.

The border should be hung last, and can be cut in five or six pieces, should it be easier to hang it that way. Do not commence in the corner, but have the end lap over on the wall about 4 inches. Cut the border through the center of the largest figure, as then a joint cannot be noticed after it is hung. Paste, fold and trim the border, the same as you did the side wall and ceiling. Take the folded strip of border, mount your platform or ladder, unfold the right end and proceed as shown in Fig. 5.

If the ceiling should be uneven it is best to draw a chalk line on the wall immediately under the ceiling. Make your chalk line in the same manner as described in the instructions for hanging the first strip of ceiling (see line in Fig. 5). This should be done on a line with the lowest part of the ceiling. This will leave the ceiling paper exposed above on the wall in some places. For this reason it is recommended that in hanging the ceiling paper, the paper be allowed to come down two inches on the side walls.

FIVE-YEAR SUBSCRIPTIONS.

In response to numerous requests, the publishers of Popular Mechanics announce a special subscription offer of five years for three dollars. Adress may be changed as often as desired.

Wealthy Resident—"Why don't you call for more firemen, chief?"

Chief of Volunteer Firemen—"Well, you see, we get only one keg of beer for putting out a fire, and the fewer there are of us the more beer we shall have to drink."—Fliegende Blaetter.

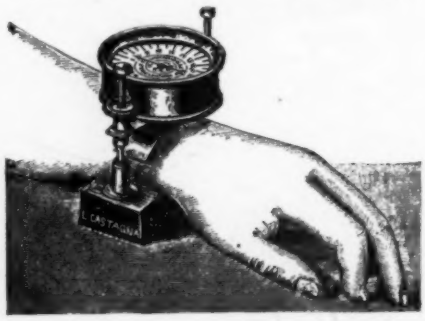
We should be glad to have our readers send us the names of any of their friends whom they think would be interested in Popular Mechanics.

PETROLEUM MAKES CLOTH WATER-PROOF.

Petroleum is said to be the secret substance used in the manufacture of water-proof cloths, of which so many articles are now being made and which appear as any other ordinary cloth. The only reliable water-proofing is obtained by impregnating the cloth outside and in with a fine film of waxes. Paraffin wax is the staple, but owing to its low melting point, it is not fit for use alone. The composition used is so alloyed with other waxes and chemicals that at a boiling point, with the water, the wax stands firm. A rather elaborate preparatory form is gone through and after the wax has been applied a finishing process is required. It is the petroleum, however, that keeps out the wet. It is this that makes so many cloths now exhibit the powers of the duck's back. Wool, cotton, silk, linen, velvets, braids and even ship's sails are thus wrapped in an invisible film of rock oil.

PULSE CONTROLLER FOR OPERATIONS.

A French surgeon has invented an instrument which shows plainly the condition of the pulse in a patient while under the influence of chloroform or other anesthetic. The importance of a most careful watch of the pulse under such circumstances is well



Instrument that Registers the Pulse Beats

understood by the medical profession, one doctor doing nothing else during the operation. The instrument is said to be much more reliable than the fingers which lose their delicate sense of touch during a long operation. The instrument registers on a dial with a pointer which moves as the pulse rises or falls.

Enables One Man to Lift Tons

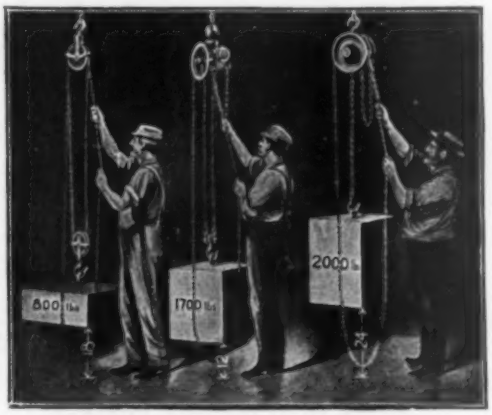
Block Added to the United States Army Equipment Would Make Any Person as Strong as Samson

Triplex Block

Nearly any man can be a Samson in this day of American mechanism. A little man weighing not more than 130 pounds can now lift a weight that would have strained Mr. Samson with all his long hair and muscles. Lifting a ton with one hand is no trick at all for a man of today when aided by a chain block that has just been added to the equipment of the United States army for serving heavy ammunition in the coast defense magazines. This lifting block, which because of its wonderful powers is attracting great attention in America and Europe, is to the man of today what the whiskers were to Samson. With it he is a giant. Without it he is no stronger than any other man. Thus in the 20th century machinery has enabled all of us who desire to become giants.

The block is triple geared, having the equivalent of three parallel shafts connected by power multiplying gears and giving nearly three-fold the efficiency of other blocks. It is hence called the "triplex block." The feats of lifting that can be performed by this simple little machine are almost beyond belief. With the triplex one ton block one man can lift a ton a foot in half a minute by pulling only 82 pounds. Thus in lifting the ton weight the strain on him is no greater than if he were lifting 82 pounds. Ten tons can be lifted by pulling only 140 pounds and 20 tons by a pull of 280 pounds. In lifting one ton the man handles 31 feet of chain; in the 10 and 20-ton lifts, 210 feet are handled. The ponderous mass of rope, tackle, jacks, skids, crow bars and rollers formerly employed in lifting great weights are done away with in the triplex and its kindred machines, called the duplex and the differential.

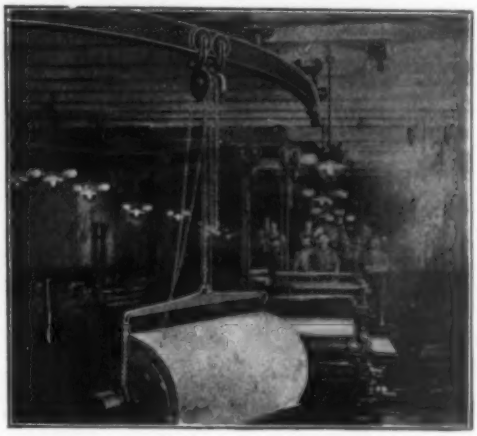
In its standard form the triplex is a portable machine intended to be hung by its hook to some overhead support, either fixed or movable, but it is also arranged to attach to a trolley intended to travel either on a crane or on an overhead tramway. It is thus available as the hoisting device in almost every type of machine for the handling of material, and has long been in service in many factories and other commercial establishments.



Differential **Duplex** **Triplex**

The picture shows the weight and height a man can lift in half-a-minute with one ton blocks. To lift a ton a foot: With the Differential three men can do it easily by pulling 216 lbs. and overhauling 30 feet of chain; with the Duplex one man does it by pulling only 87 lbs. but overhauling 59 feet of hand-chain; while with the Triplex one man pulls 82 lbs. and handles only 31 feet of chain.

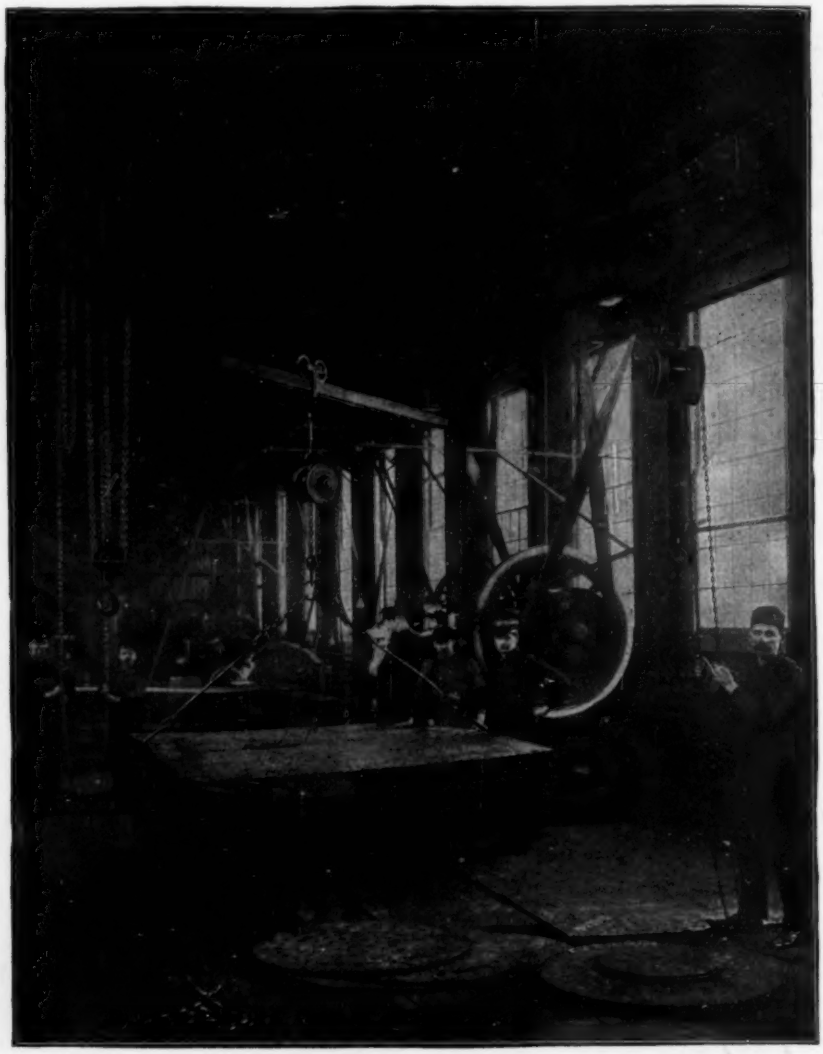
Prof. R. H. Thurston, formerly of the United States engineering corps and author of "A History of the Steam Engine," in describing this new addition to the army



Switching a Paper Roll

states: "The triplex block has a simple and triple train of spur gearing and thus develops remarkably high efficiency, so that it becomes impossible to rely upon friction to

sustain the load. For this a separate and simple device is introduced. This independent sustaining mechanism automatically holds the load safely and yet enables it to be lowered with slight effort and at high efficiency. A new and independent device is introduced to control the lowering, this device causing no friction in hoisting and being perfectly reliable and effective for its purpose."



Corner of Boiler Shop

Scene in the Shop of the Lidgerwood Manufacturing Co., builders of hoisting engines, who handle the entire output in the machine and erecting shops, and ninety per cent in their boiler shop, by means of Triplex Blocks

velocity, but without increasing the danger. The secret of its success is that instead of relying on friction to prevent the load from running down, the triplex is designed to reduce friction, both in hoisting and in lowering and to obtain the highest

The triplex block, with its independent and automatic sustaining device, is said to attain an efficiency of more than 79 per cent.

The hoisting mechanism consists of a direct train of spur gears from the small pinion on the central shaft to the internal gear

wheel cast within the main frame. The two intermediate gears between the pinion and the internal gear are carried on the circular frame or cage and roll around within the internal gear, thus forming a sun and planet motion giving the desired leverage.

The great advantages of the double arrangement of intermediate gears are balanced journal pressures, increased wearing surface, subdivision of strains and accurate equalizing of the load, resulting in diminished friction and wear. The frame carrying these intermediate gears is keyed fast to the hub of the hoisting chain sheave, and the central pinion shaft is driven by the hand chain wheel so that the power is transmitted from the handchain to the load chain through a direct spur-gear train of high efficiency.

The sustaining mechanism at the hand chain end of the block consists of a set of discs, one of which has external ratchet teeth engaging with a drop forged pawl. The hand chain wheel is screwed upon the central spindle and clamps the discs tightly to the shaft in hoisting, or if the shaft tends to revolve under the pull of the load. The parts thus clamped together act as one, and the ratchets offer no resistance in hoisting. When the direction of the hand chain wheel is reversed in lowering, it unscrews, the ratchet disc being held by the pawl, and the load is lowered against the friction of the discs under control of the hand chain, the stoppage of which causes

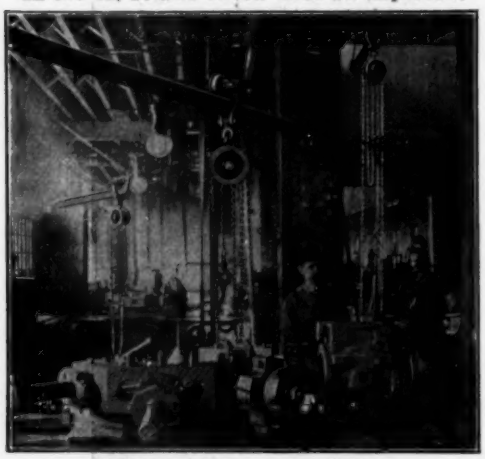
Erecting Shop

The center bays are covered by traveling cranes equipped with 5-ton Triplex Blocks. Individual machines are served by smaller Triplex Blocks, suspended on trolleys, or on light jib-cranes swinging from the columns, which support the traveling cranes.

Lifting a Boiler Suspended from I Beams

the discs to tighten and sustain the load perfectly.

In the 12, 16 and 20-ton sizes an important



Making the Triplex Do the Lifting

advantage is their two independent hand chains, which may be worked both together or one at a time.

STREET CAR CROSSING SIGNAL.

The street car lines of Dresden, Germany, are equipped with a signal system warning teams and pedestrians when the car is approaching across street. A box two feet long is suspended in the middle of the street above the car tracks, and when the approaching car is within half a block, a bell rings and the word "Halt" shows in red letters. The signal is worked by electricity, and the lights go out as soon as the car passes.

AS TO WAR VESSELS ON THE LAKES.

Old Canadian-American Treaty Held Obsolete and Void—Many Lake Ships May Appear

Two new cruisers are soon to be ordered for Canada, one for service on the great lakes, and one for service on the Canadian Atlantic coast. The one for the lakes is to be of 540 tons burden, 167 feet long and 22 feet deep. It is to have high speed and is to take the place of the present slow vessel built for service on the upper lakes under the agreement of 1817.

This agreement, which was made between the British minister at Washington and Richard Rush, acting secretary of state, April 28, 1817, provided that the naval force to be maintained on the lakes by the United States and Great Britain should be confined to the following vessels on each side: "On Lake Ontario, one vessel not exceeding 100 tons burthen, armed with one 18-pound cannon; on the upper lakes, two vessels of like burthen and armed with like force, and on Lake Champlain, one vessel similar to that on Lake Ontario and armed in the same way."

This agreement has been modified to meet changing conditions, the old cruiser Michigan having a displacement of 685 tons and carrying six guns, but Canada has clung to the limitation as to the number of vessels, and recently has shown opposition to the establishment of the proposed naval training station on Lake Michigan. The suggestion that training ships be maintained on the lakes by the United States and Canada has also met with opposition, the Canadians protesting against what they speak of as the treaty of 1817.

The arrangement as to war vessels on the lakes was in no wise a treaty, but merely an agreement. The Under Secretary of State at Ottawa has recently directed attention to the fact that there is nothing in any existing arrangement limiting the number or armament of ships which either the United States or Canada may maintain on the lakes. He believes that the agreement of 1817, with its provisions for obsolete vessels, is not binding and is voidable by either party on six months' notice.

This, the American authorities, too, believe, is correct, and if Canadians wish to abrogate the agreement of 1817 the United States is ready. Meantime the naval station will be established on Lake Michigan.

MECHANICS FOR YOUNG AMERICA

How To Make Your Own Fishing Tackle

Hurrah! it is fishing time. In April the fish bite better and they taste better than in any other month. So get out your fishing tackle, boys, and ho for the lakes and streams. This year don't spend so much of your parents' money for fishing paraphernalia. Make it yourself and you will feel prouder of it and the old folks will feel prouder of you, and you will be the envy of all the boys around.

If you want to fish and engage in some other sport at the same time, you should by all means have a fishing semaphore. This instantly shows from a distance when a fish is on the hook, and any boy can make it. The line may be baited and set, and the fisher can give his attention to other things, with only an occasional glance at the signal. To make the semaphore take a piece of board about 12 inches square and 2 inches thick. If a single piece cannot be obtained, build a block of this size out of small stuff. Bore a hole in the center one inch in diameter and in this drive a scantling 2 inches square, 12 or 15 inches long and pointed at the lower end. Now take a piece of wood 2 inches wide and 5 inches long for the semaphore and round two of the corners, as shown in the cut. Bore a small hole 2½ inches from the tapered end and fasten the board to the scantling by driving a small round nail at A (Fig. 1). Drive another nail at B, leaving the nail head protrude one-half inch from the scantling to serve as a rest for the semaphore. The board should be made to turn easily on the pivot nail. At C fasten a strip of thin sheet iron, bent flat at the top, so as to support the semaphore in place when it is sprung—that is, when it raises to indicate a fish is caught. The free end of this strip or spring rests on the outside of the semaphore when it is down, and supports it when it is up. It should not press too tightly against the signal. At D drive a small nail and attach the fishing line. When the fish takes the hook it will throw the signal up to a horizontal position and the spring C will hold it there. The semaphore may be painted red, or white, or to bear the word "Fish."

In the January issue of Popular Mechanics were described methods of winter fishing that may very easily be applied to spring and summer fishing, with slight alterations which any boy with a bit of mechanical ingenuity can figure out for himself. For instance, the "jumping-jack" fisherman can be built on a big floating board with a 2-inch hole under the jumping-jack for the line to pass through, just as easily, if not easier, than on the ice. The "tip-up" is also of great amusement in spring and summer, and can be erected by aranging the "tip-up" between two logs or heavy timbers.

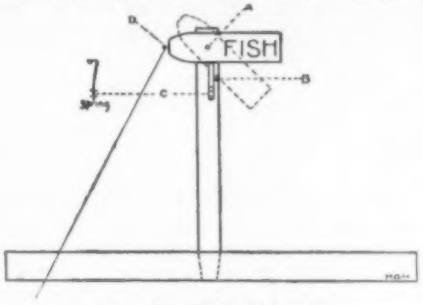


Fig. 1.—The Fishing Semaphore

Bass and pickerel have an irresistible hankering for bait on a hook trolled by toy boats. These boats serve the purpose, however rudely made, and one boy can operate a whole fleet of them if he have a large boat by which he can row to any one of the small boats immediately when he notes a fish is hung. The boats can be made of a piece of plank, say 2½ feet long. The board should be sharpened at one end and rigged up with a couple of cloth masts (Fig. 2). The most important part of the craft is the rudder. This should be very long, to prevent the boat from making lee way and to keep it from changing its course. Drive a couple of nails in the stern of the boat, to which tie the fish lines, hooked with spoon or live bait. The small boat does not

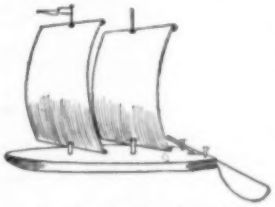


Fig. 2. Toy Fishing Boat

scare the fish as a large one does, and the bait pulled along by it is wonderfully attractive to members of the finny tribe, especially when trolled before the wind.

If proper fishing tackle is not accessible, it is very easy to manufacture it yourself.

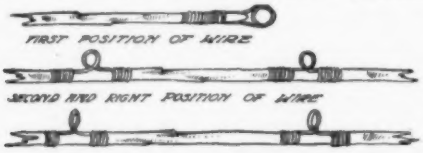


Fig. 3.—Method of Making a Trout Rod

To make a trout rod first secure a long, straight, elastic pole, such as can be found in nearly any wood. Then secure some pins and a small piece of wire. File off the heads of the pins and bend them in the shape of the letter U and drive them in the rod on the same side at regular intervals, beginning at about 2½ feet from the butt end of the pole. Drive the pins just far enough in to permit the line to pass freely under the loop. To make the tip bend a circular loop in the center of a piece of wire and knot or bind the wire to the end of the pole, as shown in the illustration (Fig. 3). If you have plenty of wire, it will make better loops than the pins. Cut the wire into short pieces about 3 inches long, loop each piece in the center. Then with more wire or with strong, waxed thread bind the ends lengthwise on the rod, as shown in the illustration (Fig.3). After the binding is secure, twist each loop around to its proper position.

A large wooden spool, an old tin can and a thick wire will serve to make an A 1 reel. Run the wire through the spool and

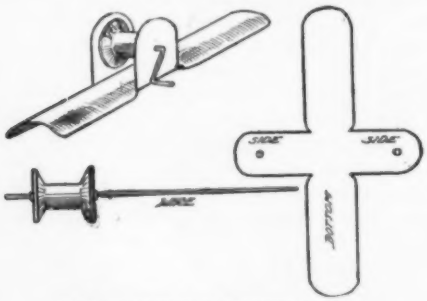


Fig. 4.—Method of Making the Reel

wedge it tightly so that one inch protrudes at one end and three inches at the other. From a tin can cut a piece of tin of the shape shown in Fig. 4. Two protruding parts are left on each side to be bent up for side pieces, to serve as rests for the axle tree. After the side pieces are bent up in the proper shape, punch a hole in each and insert the ends of the wires through the holes. See that the spool revolves freely, and then bend the long end of the wire in the shape of a crank. Hammer the tin over the rod until it takes the exact curve of the rod and fits snugly. Then bind it firmly to the rod with strong twine. It is difficult to make a fish hook, though many good perch and cats have been caught with bent pins. A strong steel wire can be bent and filed to a point and a notch filed above the point for the barb. Fish hooks have been made of birds' claws. The claw is bound to a piece of shell by vegetable fiber. None of these home-made hooks are satisfactory, however, and it is better to carry a good supply with you.

Fig. 5.—Simple Minnow Net.

Inside the hat band is a good place to carry small hooks.

Live minnows are the best bait for black bass, pickerel and many other kinds of fish, and to catch live minnows you need a net. One of the simplest minnow nets is made by fastening two sticks to the ends of a stout piece of mosquito bar. If desired, the net may be provided with floats at the top edge and sinkers at the bottom, as in the illustration (Fig. 5). Old sieves and pieces of meshed wire can often be transformed into ideal minnow nets.

A good landing net may be made from a forked stick and a piece of strong mosquito bar, or preferably a ball of twine. Bend the two ends of the fork until the ends overlap each other and bind them tightly together, as shown in the cut (Fig. 6). Waxed twine serves best in all such binding work in making reels, nets and other tackle. Now, if the net is to be made of mosquito bar, sew the mosquito bar into the shape of a bag and fasten the mouth to the sides of

the loop described by the connected forks of the stick. A better net is made from twine. Fasten the pole in a handy place, with the hoop suspended vertically a little higher than your neck. Cut a number of

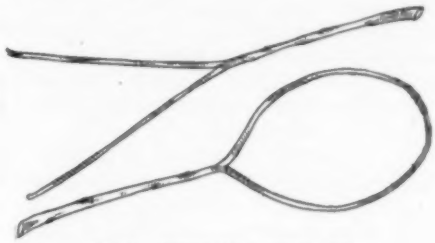


Fig. 6.—Frame for a Scoop Net

pieces of twine each about eight feet long. Double each piece and slip it on the loop with the loose ends hanging down. Arrange the double strings this way all around the loop. Now begin from a convenient point, take a string from each adjoining pair and make a simple knot of them, as shown in the diagram (Fig. 7). Continue all the way around the loop, knotting the strings together in this manner. Now begin on the next lower row, and so on until a point is reached where you believe the net ought to commence to narrow or taper down. This is accomplished by knotting the strings a little closer together and cutting off one string of a pair at four equidistant points in the same row. Knot as before until you

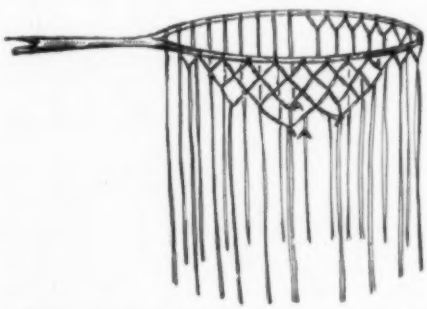


Fig. 7.—Showing Method of Weaving the Scoop Net

come to a clipped line; here take a string from each side of the single one and knot them, being careful to make it come even with others in the same row. Before tightening the double knot pass the single string through, and after tying a knot close to the double one, cut the string off close (Fig. A).

Continue as before until the row is finished, only changing from the first plan when a single string is reached. Proceed in the same manner with the next and the next rows, diminishing the number of strings remaining until the remaining ones meet at the bottom. Be careful not to let one drop mesh come directly under another of the same kind.

A bucket or old tin can with the top and sides perforated by means of a nail and hammer (Fig. 8), will serve as a minnow bucket. The illustration (Fig. 9) shows the proper way to bait a hook with a live minnow. The cartilaginous mouth of the minnow has little or no feeling in it, and when thus baited the minnow is not killed and swims about promiscuously, thus standing a much better chance of catching

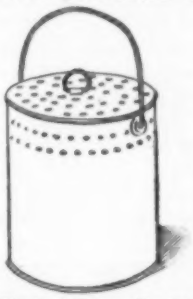


Fig. 8.—Minnow Bucket

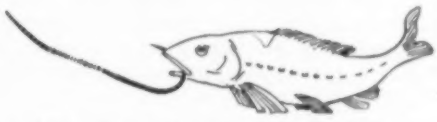


Fig. 9.—How to Fasten a Minnow on a Hook

a fish than when cruelly mangled by the hook of the ignorant fisherman.

BRITISH SAFETY-LAMP DEVICE.

A recent English invention is believed to give absolute safety to oil lamps. The device consists of a circular metal box in the bottom of which is a deposit of salt over which is placed a layer of specially prepared cotton waste. Running through the waste is an asbestos wick, woven by hand. The box, which is pierced with numerous small holes, is then immersed in the oil until the cotton waste will absorb no more. The box is then wiped dry and is ready to use. The lamp may be overturned or thrown about with perfect safety. The device is adaptable to all kinds of oil burning lamps, and is said to yield more light from the same amount of oil.

Navigation on the great lakes will open late this year. In January Lake Michigan was frozen from shore to shore and even now at points on the west shore the pack ice is piled up 40 feet deep from the bottom.

Wireless Telegraphy For 1904

Signor Marconi Talks of His Plans and Improvements Being Made

BY GUGLIELMO MARCONI.

What are the prospects of wireless telegraphy for the ensuing year? It is a big question and an indefinite one. It must be remembered that wireless telegraphy is yet only in its infancy. To some extent it has emerged from the experimental stage—that is, over certain distances it is an actual practical working system—scientifically and commercially perfect. In overcoming long distances its practical utility has also been demonstrated, but it has not been able so far to justify itself on commercial grounds. That is what I mean when I say it is only in its infancy.

I know from my own experience, from my own positive knowledge gained by incessant labor, that the transmission of signals across the Atlantic is thoroughly practicable. It has been done and it is being done and in the approaching year I have every reason to believe that I shall be able to maintain a full and efficient service between Great Britain and the United States.

My continuous experiments and the improvements I have made in my apparatus warrant me fully in making that prophecy, and I do not usually prophesy unless I know. There a'e many doubters and skeptics, rivals and others who have poo-poohed its practicability for trans-Atlantic messages—well, before 1904 is out they will be sorry they spoke.

At the present moment we are negotiating with the United States government for the establishment of wireless communication between the American continent and the Philippines and in the event of the United States acquiring new colonies—for you are an expanding power now, you know—we shall hope to be permitted to establish our wireless system there also.

Not only do we work forward with confidence to establishing wireless communication on a commercial basis between Great Britain and the United States, but also between the United States and the continent of Europe. I do not want to expatiate on the advantages it will be to the world's commerce and thought when this cheap and perfectly reliable, if invisible, method of communication is established between the new world and the old. Its results cannot fail to be great. I might be justified in using a bigger word, but prefer to await the justification of events.

Our next important experiment will be the connection of Italy and South America by the wireless system. It is a distance of 6,500 miles, nearly double that to America from London, and I may say we are as certain of success in this as over the shorter distance. The Italian government is offering us every assistance, facility and encouragement in setting up this installation and is perfectly satisfied, moreover, with the proofs we have furnished of the progress we are making.

At present we are working for the British admiralty on wireless communication between London and Gibraltar. It is proving most successful and of the 1,000 miles 500 is over sea, while 500 is across the Spanish peninsula. There is no interference with our signals over that distance, and one of the most important developments of the near future will be the absolute security with which we can transmit over any distance without any possibility of interception or interruption, whether accidental or designed.

I need not dilate on the uses to which our system has been adapted on ships. Over 100 ships are now equipped with the Marconi apparatus, sixty of them warships, the others being trans-Atlantic and other liners. I know that the installation is immensely appreciated by the ships using it, and before long the big vessels of the White Star line, including the Cedric, following the example of Cunarders, will be fitted with our apparatus.

Did you notice that Popular Mechanics was the first to give the inside history of the Japanese-Russian controversy; telling how England was the real instigator of the trouble, and how London colored the press reports sent out to all the English speaking people in order to create the kind of public sentiment England desired? Did you notice that Popular Mechanics in recounting the Iroquois disaster said that the destruction of a few skyscrapers would be necessary to cause more substantial structures of this kind just as the destruction of the Iroquois was necessary to cause more substantial theatres? Well, Baltimore has since burned, skyscrapers were destroyed and the result will be better buildings of this class. There is always good and important information in Popular Mechanics.

Railroad To Mohammed's Shrine

American Company Building the Rails for the Line from Beirut to Mecca

The Maryland Steel Company has been awarded the contract and has begun work upon the steel rails for the Hamadie du Gedjaz railroad which will run from Beirut, on the Mediterranean coast of Turkish Asia Minor, to Mecca. The rails will be laid down at Beirut at $22.88 a ton, although they are the same rails that are sold to American roads at $28 a ton on board the cars at the factory. It is fair to assume that even at the lower price the company makes a profit.

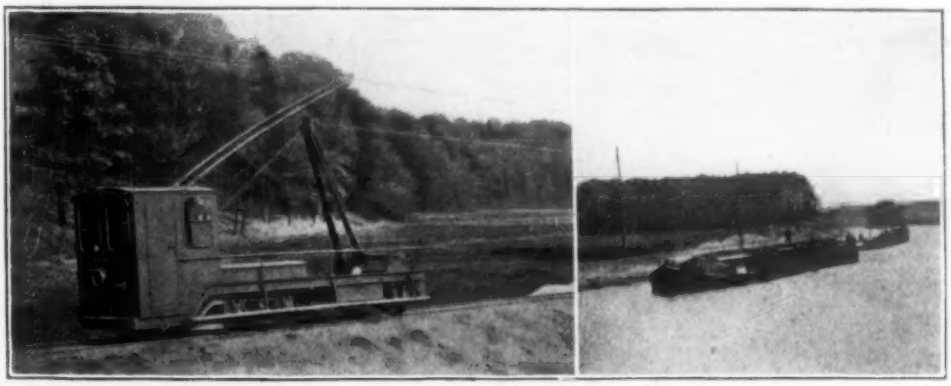
The completion of the road will work some significant changes. It will be interesting to note whether the pilgrims by foot or by canal to the tomb of the prophet will rapidly decrease and transportation by railroad take the place of the long and laborious pilgrimages which have been made for centuries.

The only element of uncertainty is that down to the present time this pilgrimage has imparted a kind of "odor of sanctity" to the pilgrim and the longer and more difficult the pilgrimage the more of loyalty to Mohammed was considered to be displayed, and the higher the Hadji's reputation for piety rose among the "faithful." The iron horse must bring with it occidental influences, comforts and customs, and it is fairly to be presumed that by degrees more and more Mohammedans will make their pilgrimages by train to the shrine, thus saving time, money, fatigue and trouble.

It is also hoped that the completion of the road will remove one source of danger to the eastern world—that caused by the filth of these pilgrims. In a multitude on pilgrimage they are indescribably filthy and the result has been that their loyalty to their faith has been the cause of thousands if not millions of deaths and has imperiled other parts of the world.

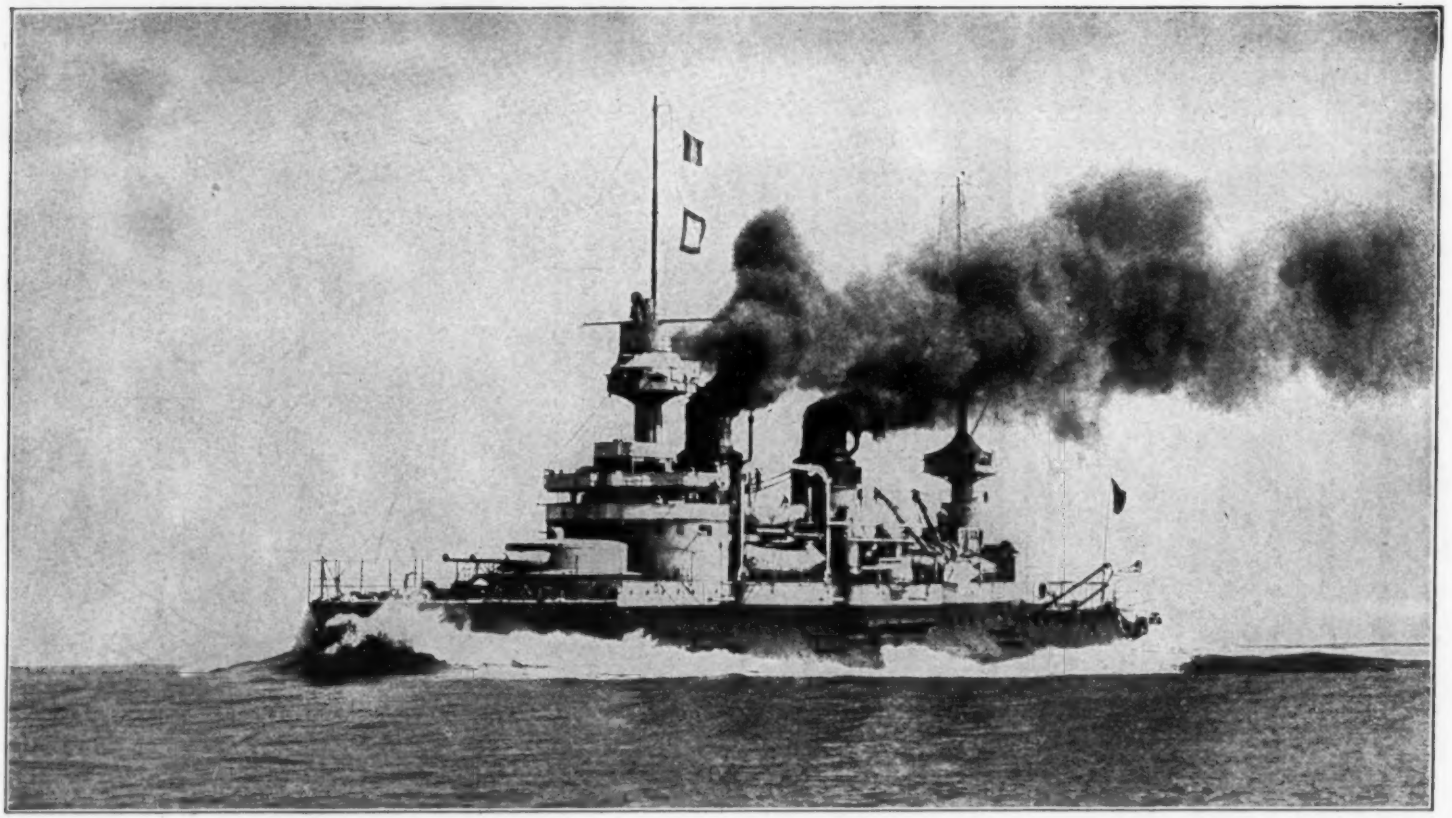
THE ELECTRIC "CANAL MULE."

The system of hauling trains of canal boats by means of an electric locomotive as employed on the Miami and Erie canals between Cincinnati and Middletown, mentioned in the March issue of Popular Mechanics, marks a new era in canal traffic. The method is the same as is employed on the Tetlow canal of Germany. The power for the electric motor is obtained from generating stations, the current being conveyed by overhead wires. The locomotive has been referred to in Popular Mechanics as the "electric canal mule," in that it supplants the old system of canal haulage that was rapidly decaying before the onward progress of steam and electric transportation. The electric canal haulage, however, promises to revive the importance of the canal and to greatly increase the amount of canal traffic. Trains of boats, often numbering as many as ten or more, are hauled through the water by an electric towing locomotive which runs along the canal bank. The application of electricity for this work paves the way for the electrification of the enlarged Erie canal in New York, as well as of other canals.



Towing Boats by an Electric Motor on the Tetlow Canal Near Berlin.

New Pride of the French Navy



THE FRENCH BATTLESHIP, ST. LOUIS, is the newest and most formidable addition to the French navy. The St. Louis is a battleship of the first class, of 11,275 tons' capacity, and of 14,500 horsepower. She has a speed of 18 knots. The official description of the boat, contained in the Journal of the United States artillery, gives the following data:—Armor protection: Water-line belt, 15.7 in.; tapering to 10 in.; upper belt, 3 in.; turret, 15.7 in.; armored deck, 3.5 in. Armament: Four 12-inch guns in turret, one forward and one aft; ten 5.5-in. quick-firing guns; twenty 3-pounder quick-firing guns; four 1-pounder quick-firing guns; and thirteen machine guns; with four torpedo tubes (two submerged).

The Future of Radium

By M. Pierre Curie

It is quite difficult to predict the future of radium, but I believe its field will be in the domain of medicine, rather than of warfare and commerce. A physician with a tenth of a grain of radium could receive an unlimited number of patients and probably effect cure after cure in cases of lupus and cancerous affections. The scope of radium is naturally affected by its enormous cost, as an ounce is worth a king's ransom. Recently, however, I received a communication from a firm in Buffalo, N. Y., claiming to have a new process of extracting radium from uranium, which may cheapen the article.

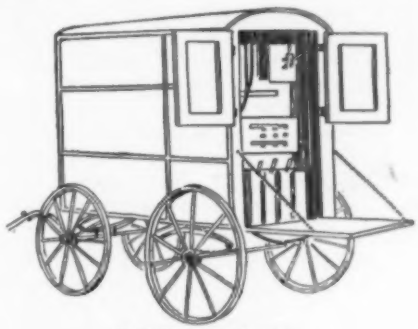
Radium might be a factor in warfare in the way of producing explosives in a magazine, causing the disappearance of the ship and the entire ship's company. But radium is dangerous against individuals rather than objects. A tenth of a grain left contiguous to a person is capable of producing complete paralysis. For this reason it would prove a dangerous medium in causing crime which would defy detection, if it ever become as easily obtainable as other chemicals. It is also dangerous to bring a tenth grain in contact with a highly charged electric battery, because an immediate explosion is certain. At first we hoped that the blind would be benefited by it, for a particle of radium inclosed in a box, placed on the forehead, conveys a sensation of light to the eye. But we found it did not enable the blind person to distinguish objects. So far we have only used radium salts, and in minute quantities, yet the remarkable results produced show the possibilities of the pure product are inestimable.

A man entering a room where there is a pound of pure radium would perish, but there is no fear of this, as only radium salts are yet obtainable from the barium found in Bohemia called pitchblende, of which a ton often yields less than a gram of radium salts. Already the mineral of Jachimsthal, which gave my wife and myself our first material, is exhausted, and only the discovery of a veritable Klondike of radium will demonstrate the wonderful force of this chemical so little understood even by its most ardent investigators.

Before doing what Prof. Gustav Lebon has suggested, the blowing up of magazines, forts and arsenals in the enemy's country by using a small tube of radium, we shall have to find the requisite amount of pure radium. Its potentiality is wonderful, and I can even perceive a radium cannon projecting electric shocks at great distances with deadly effect.

PORTABLE SUB-STATION.

The electric company at Sheffield, Eng., have provided some portable sub-stations which can be drawn about by horses. In this station is all the machinery and switchboard for supplying a single or two-phase current at 400 or 200 volts. The portable



Portable Transformer.

station can be connected up in a short time, and is especially convenient for emergency or temporary requirements. The arrangements seem odd to us in that the outfit is not moved by an electric truck instead of horses. The Electrical Review, London, says: The whole apparatus can be drawn about by horses, deposited in a convenient spot, and connected up in a few hours to supply any temporary demand, such as an exhibition, construction works, or permanent consumers during the erection of a district sub-station, to which the load can be changed over on completion, and the van moved on to some other sphere of usefulness.

When trolley cars took the place of mule cars in the city of Mexico they brought to an end an old-time custom. Formerly when a Mexican left a car he felt obliged to shake hands with every one he knew on the car. Every time the car stopped the process was repeated and the result was the journey was a tedious one. When the trolley cars were put in service an order was issued not to wait for formal leave takings.

May Dispatch Letters and Parcels by Wire

The "Electric Post" Threatens an Upheaval in Present Methods of Mail Delivery

The "electric post," which may be the means of transmitting letters and parcels along electric wires at a speed of 250 miles an hour is being promoted in England. American capitalists have their eyes on the venture and it may not be long before we are sending and receiving letters and packages by electricity between the principal cities of the United States. Many in England believe the "electric post" will prove the most important mechanical development since the first railway was built; that it will soon do away with railway mail trains, letter carriers, sorting clerks, etc.

The "electric post" is the invention of Count Robert Piscicelli Taeggi, of Naples. He has already formed a syndicate of English capitalists in London for the purpose of establishing the system in Europe. The Italian government has granted the inventor a concession for operating the "electric post" between Naples and Rome.

The system is worked throughout by electricity. By its means a letter could be posted in Chicago and a reply received from New York in the same day. A St. Louis draper could place an order for light goods with a Chicago dealer and have the goods delivered before night; for the electric post can carry parcels as well as letters.

To better explain the working of the system, let it be supposed that the dome of the new Chicago postoffice is the central station of the "electric post" for service in the city of Chicago. From the top of the tower wires would converge in all directions, reaching throughout the city, supported at intervals by columns 50 feet high, called collecting poles. There would be a pole about every block along the principal business streets of the city. At the base of each of the posts there would be a box in which to post the letters. An automatic arrangement inside the box would deface the stamps on the letters, at the same time inscribing the latter with the number of the collecting pole and the date and hour of posting. Every five minutes there would be sent from the central station an empty box, with motor attached which would run on wheels along the wires. The wires would not only fill the same purpose as rails, but would act as conductors of the electric current to drive the motor. On reaching the first collecting pole the box would stop and open itself. At the same time it would cause the collecting box at the base of the column to run up the center of the latter and empty its contents in the receptacle provided. The motor box would then resume its journey, calling at each city pole in turn. Having performed its circuit the motor box with the letters would return to the central station. There the letters would be sorted and those for other cities would be placed in similar wheeled boxes and dispatched along the wires to their destinations.

Practically speaking the electric post is an electrical aerial railway, with letter boxes in place of carriages. Cities of the size of St. Louis, Boston, Philadelphia, Washington, Buffalo, Cleveland, Kansas City, San Francisco and New Orleans would be in direct communication with New York and Chicago. Smaller towns would be served from the nearest important center, to which letters would be transmitted in the first place. A great network of wires would be spread over the United States.

To avoid the possibility of boxes colliding while on their way, two sets of wires would be provided, one for the outward and the other for the inward journey. Boxes traveling in the same direction would be kept three miles apart by a "block" system. "The vehicles follow one another uninterruptedly," says Count Taeggi, "and obey, as it were, the word of command given them at the start."

The count has provided against the possibility of the mails being robbed while on their mid-air journey. Every supporting pole would be fitted with a fulminating ring, which he calls "the ring of death." Being connected with one of the high potential wires, this ring would inflict a fatal shock upon any stranger climbing to the top of the pole.

The count claims that the United States government would realize a great saving by the adoption of his system, for it would dispense with thousands of employes and many appliances, of which mail bags alone now cost the government many thousands of dollars a year.

Send for our premium list.

Train Carries Court House Bodily From One Town to Another

Spreads Wonderment and Consternation in Its Path as It Speeds Over Nebraska Plains

Here is a reproduction of a photograph illustrating how justice may be dragged about by a tool of the corporations. The locomotive is the "tool" and "justice" is the court house that the locomotive is hauling in Nebraska from Henningsford to Alliance, a distance of 20 miles. The Railway Conductor, an authority on railway affairs, calls it a case of "justice on wheels."

Court House in a Train Speeding Over the Plains in Nebraska

The Burlington train, hauling this courthouse was an object of great curiosity as it sped through the country without loss of time, and it is the first case on record where a building was shipped intact by railroad from one town to another. The court house, it will be noticed, is loaded near the front of the train, the caboose being about ten cars in the rear. This shipping of the court house bodily on a regular freight train is the result of a bitter fight between two rival towns. Henningsford was the county seat and consequently had the court house until Alliance grew to greater size and power. Then came the tug of war. Alliance had the money and the votes and so was chosen as the county seat. Next followed the job of moving the court house. This, with modern methods, was regarded as an easier and more economical method than the building of a new court house in Alliance.

The court house was 40 by 50 feet, two

stories high, with heavy truss roof constructed with a heavy pine frame weighing 100 tons. A housemover from Lincoln contracted to move the building. He first started to perform the work by teams and rollers, but found that he could not thus complete the job in the allotted time and appealed to the railroad company, which came to his rescue. J. R. Phelan, superintendent of the road, intrusted the work to E. W. Bell, superintendent of transportation. The structure was loaded on four 50,000 pounds' capacity trucks. When ready to start the distance from the track to the top of the deck on the building measured 50 feet. Truss rods were made of 3x6 stringers over each truck. As a stand board to hold truss together 1x6 planks were used. To keep the building from rocking a set of double block and falls were secured to the top corners, brought down opposite each side and secured to 60,000 capacity coal cars loaded with coal.

From a distance the train looked as if it had run through the court house and was thus carrying it along wedged to the cars.

As the train with its court house swept along over the rails country folks ran out to see; cowboys rushed toward it on horseback; farmers left their plows and gazed long in wonderment; housewives called their neighbors; children rushed from the schools and the teachers went with them, and all along the trip the train spread astonishment and excitement in its path. Arriving in Alliance, the whole town with a brass band was in readiness to welcome it. A shout went up as the court house first of all was seen in the far distance winding its way along the plains. Nearer and nearer it came, into the station it rode and Alliance had a new building—a court house. A temporary track was built and the hall of justice switched to the site where it now stands. Long will the farmers, the Nebraska cowboys, the school children and the residents of the two towns tell of the day when the court house was shipped by freight from Henningsford to Alliance.

THE COTTON BOLL WEEVIL.

The cotton boll weevil is a destructive insect which made its appearance here in 1899, and caused a loss last year to the cotton planters of $15,000,000. Its ravages thus far are confined to the eastern half of Texas and a narrow strip of western Louisiana. The weevil egg is deposited in the cotton boll where it hatches in three days into a grub and begins to eat the cotton in the boll. In from seven to twelve days it grows to a length of about half an inch, when it spins a cocoon like the silk worm.

The Five Stages of the Cotton Boll Weevil

Three days later there emerges the adult weevil, which is a small beetle a quarter of an inch long with a sharp beak half as long as its body. With this beak it pierces the boll and deposits an egg, after which it dies. From egg to adult weevil takes only three weeks.

Great Buildings of America

The Railway Exchange of Chicago

Its white walls reaching 240 feet above the ground on the lake front, with 700 windows looking out on Lake Michigan, the new Railway Exchange, which has just been completed, is one of the pride mansions of "Chicago's front yard." This splendid structure was built by the united efforts of railways entering Chicago as their permanent home.

The building is 16 stories high with attic, making practically 17 stories. Its cost was $2,500,000. It covers a ground area of 30,000 square feet at the corner of Jackson and Michigan boulevards. The exterior construction is of white glazed terra cotta with bay windows from the fourth to the twelfth floor inclusive. Entrance from Jackson and Michigan boulevards lead into a magnificent rotunda finished in marble and mosaic. The central court, 60 by 70 feet, reaches to the 14th floor, above which level the space is extended to 89 by 91 feet. Corridor floors are of mosiac and the walls are wainscoted with marble up to the height of the transom.

An idea of the immensity of the structure can be obtained when it is stated that it contains 6,000 tons of steel construction alone. The building contains 350,000 square feet of floor space, divided in 1,200 offices. The building alone has as many occupants as there are inhabitants, including men, women and children, in a good sized town. Five thousand people work in its offices. There are 12 elevators. An engine of 1,000 horse-power furnishes power for the structure's various requirements. There are 6,000 electric lights, and electric bells innumerable. Two thousand windows furnish light by day, and entrance and egress is obtained by 1,500 doors. Burnham & Co., architects of the building, will have occupied their offices in the structure in 6½ months from the time of starting the mason work at the sidewalk line. The building was completed in three months from the time the foundation work began. There were times during the process of construction when two stories per week of the structure were completed.

The Railway Exchange Building, Chicago

WARSHIPS TO CARRY MODELS OF THEMSELVES.

The United States navy intends to emulate Germany in equipping all warships with miniature models of themselves. The kind to be provided for each ship is known as a supplementary plan or skeleton model.

At present many of the marines and even officers often have no conception of the hidden parts of vessels. The only ship that now has a skeleton of herself aboard is the turret ship Monterey, commanded by Commander W. H. Beehler, who was a naval attaché at Berlin for several years. The model can be taken apart and the men serving on the Monterey can look under the boilers at any time instead of having to wait until the fires have been drawn. This fact alone has saved more than its cost.

EASY ELECTRICAL EXPERIMENTS

A THERMO-ELECTRIC GENERATOR.

Thermo-electric generators are devices for transforming the energy of heat into electric energy. In their simplest form they consist of two dissimilar metals joined together at two points. If one of these junction points is heated so that its temperature is above the other junction, an electric current is generated, the electro-motive force of which depends upon the difference between the temperatures of the two junctions. Some metals give much more powerful effects than others. Antimony and bismuth wires, twisted together give the most powerful effects, but these metals are not easy to obtain. The amateur can, however, easily obtain iron and German silver wires, and by means of these may construct an electric generator which is capable of ringing an electric bell from the current derived from the heat of an ordinary lamp chimney.

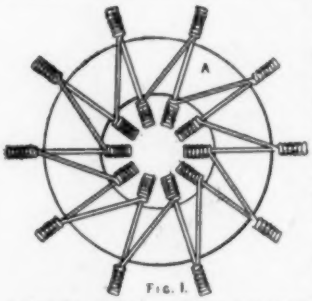


FIG. 1.

About sixty feet each of German silver and iron wires will be required, of about No. 14 B. & S. gauge. The exact size is not of importance, but the larger the wire the greater will be the current capacity of the apparatus. Having carefully straightened the iron wire cut off ten pieces each 3½ inches long. Also cut off ten pieces of German silver wire six inches long. Procure at a stove dealer's twelve pieces of heavy mica (commonly but erroneously called isinglass) of a size such that circles four inches in diameter may be cut from it. Cut out twelve mica rings like that such as A, Fig. 1, the external diameter being four inches, and the diameter of the hole two inches. Also, as an aid in construction, cut from a piece of ¼ inch whitewood a ring of the same size as the mica rings.

Using this wooden ring as a form, fasten upon it the ten pieces of iron wire, each piece pointing directly towards the center of the ring, the spaces between each piece being equal. Fasten the wires to the wooden ring by small wire staples. Then, taking the pieces of German silver wire, begin by twisting the end of the latter around one end of one of the projecting iron wires, clamping the apparatus in a vise during the process, and using a pair of pliers so as to make the twists very firm and even. Then twist the other end of this piece of German silver wire to the inner end of the next iron wire. Repeat this process around the entire ring, and the combination shown in Fig. 1 will be produced. After going completely around the ring the last piece of German silver wire should not be twisted to the first wire, but the two ends be left free for connections. The wires thus twisted may be removed from the wooden form, and should lie smoothly in place without springing or warping.

Proceed in a like manner to build up twelve such wire rings, each consisting of alternate German silver and iron wires. Although the efficiency of the apparatus depends upon all joints being very firmly made, yet, of course, it is understood that no attempt should be made to solder these joints, as the heat applied would melt the solder and ruin the apparatus. Each of the twelve units, when made, will constitute a source of electro-motive force, which may be treated in just the same manner as ordinary electric batteries. The units are piled one above the other, each separated from its neighbor by one of the mica rings first mentioned, and then the whole must be firmly fastened together by some convenient means. One method of doing this is to place on the top of the pile extra mica rings, and then by means of small bolts the whole can be tightly clamped together into one rigid body. Of course, it is understood that before they are finally fastened together the German silver terminal of one of the units is to be joined to the iron terminal of the next unit above, and so on until the top is reached. This will leave the iron terminal of the lowest coil and the

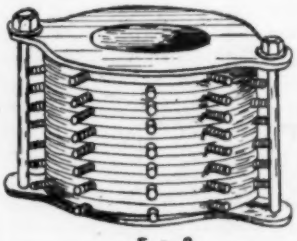


FIG. 2.

of rings two or three

German silver terminal of the upper coil as points to which we may connect an electric circuit.

To generate electric current by means of this apparatus it is necessary to heat one set of junctions—as for instance, the inner terminals—so that the temperature of these terminals is higher than the temperature of the outer terminals. As has been stated, the value of the electromotive force developed, depends upon the difference between the temperatures of these junctions, so that it is of no use to heat both. On the contrary, if some means could be devised to keep one set of junctions at a low temperature, the efficiency of the apparatus would be much increased.

The apparatus as complete in Fig. 2 works very nicely when the inner terminals are heated by placing them directly over an ordinary lamp chimney. Some sort of a support can easily be made by the amateur so that the apparatus may be held close to the chimney without resting upon the latter. The inner terminals are then intensely heated, while the outer terminals are comparatively cool. The apparatus as described will deliver a current of one-third ampere, at a pressure of 1 volt, and unlike the current furnished by electric batteries is perfectly steady for any length of time. A battery of four or five of these generators each with its corresponding lamp would be capable of running a small motor.

If the workshop of the amateur is provided with a gas jet, more powerful effects may be obtained than by the use of the heat from a lamp chimney. The objection to the latter is that the outer terminals cannot be kept cool. With a small gas jet, whose heat is concentrated at the center of the apparatus, this objection is partly overcome. Care should be taken, however, that the gas flame does not play directly upon the twisted junctions, as, if it does, the latter will soon be oxidized, and the apparatus rendered unfit for service. A small spirit lamp burning wood alcohol, may be used. As a shield to prevent direct contact between flame and wire, small pieces of mica furnish the best material. Also, if difficulty is experienced in keeping the various joints from touching each other, strips of mica laid between the wires, and clamped in place, will be found very effectual.

Every mechanic can earn something that will be of great advantage to him in his business. Very little effort required. Write to Popular Mechanics for details.

HOW TO BEAUTIFY THE BACK YARD OF A CITY HOUSE.

The back yards of city houses are, as a rule, as dismal and uninviting as possible. They are a dumping ground for old barrels, tin cans and other rubbish, and the

Before Beautifying

people living in the houses do not believe the yards could be made attractive. It is an easy thing to do, however, as the department of agriculture has shown in its interesting bulletin No. 185. The two illustrations tell the story; the selection of vines and plants is left to the individual choice of each person, and can be varied to suit the climate. The transformation can only be realized by an actual experiment.

What Vines and Shrubbery Will Do

Fathers who want to furnish a pleasant pastime for their children cannot do better than invest in a few packages of seeds the cost of which is trifling. The pictures are from photographs of the same yard taken before and after planting.

SHOP NOTES

THE EVOLUTION OF THE BELLOWS.

The great blowing engines of our modern blast furnaces, requiring hundreds of horse power and running constantly night and day, are but the outcome of the ancient method of blowing employed by the Egyptians 1500 years before Christ. The Blacksmith and Wheelwright has gathered data on the subject, from which we condense the following:

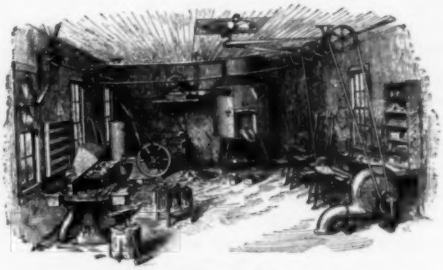
Figs. 1 and 2

In Fig. 1 is seen the Egyptian bellows, worked by men who rested their weight first on one leather bag and then on the other. Cords were used to lift the bag for another compression. The middle man is holding the rod of metal in the fire.

The Roman lamp bellows is like those still in use in this country and elsewhere. The same type of bellows, only larger, was used in pumping water, as shown in Fig. 3. The natives of British India still use the crude bellows seen in Fig. 4, for blowing charcoal fires for smelting ore. In striking contrast to all these is the scene of a modern blacksmith shop where power blowers are employed for forging, melting and ventilating.

Fig. 3.

Fig. 4.



A Modern Shop

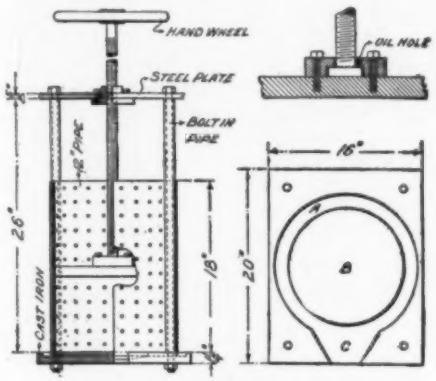
HOW TO MAKE A POLISHING WHEEL.

"For this purpose I use old felt boots," which can be obtained for little or nothing," says a correspondent in the American Blacksmith. "Each boot will make two plys. Three pairs of boots will make one wheel about 3 by 7. Put iron plates on each side about ⅛ of an inch thick, and about one inch smaller than the wheel. Bolt them together. The wheels can be made any thickness desired. To obtain a smooth surface put the wheel on emery stand shaft, use a chisel like those used for wood lathes, and hold up to the wheel on a rest. The wheel must have good speed. This makes fine polishing wheels, as they are soft and will not bump or break."

SIMPLE DESIGN FOR A WASTE PRESS.

A simple form of waste press which can be readily made from material generally at hand in a machine shop is shown in the accompanying sketches in the Street Railway Review. Only a few dimensions are given as the sizes will necessarily be varied to suit different conditions. A piece of wrought iron pipe 10x12 inches in diameter and about 18 or 20 inches in length is faced squarely at each end and drilled full of small holes of about ¼ inch in diameter spaced about 1 inch apart. A cast iron plate 1¼ inch thick is faced on top and a ring about 3 inches wide is cut as shown at A so that the pipe will fit down over the projecting part D which holds the pipe central on the plate. The front of the plate is chipped out as indicated at C, the bottom surface sloping downward towards the edge so that the oil will run off the plate.

A piece of ½-inch or ⅝-inch steel plate is used for the top of the press and this is cut about the same size as the cast iron plate at the bottom. Two plates are held apart by four 1½-inch pipes used as distances pieces, through which run bolts holding the plates firmly in place. The



Waste Press

steel plate is drilled to receive a cast iron bushing, which is threaded to receive the screw and is held in place by bolts or cap screws. The piston is made of 1-inch or 1¼-inch cast iron, and secured to this is another cast iron piece which is turned out to receive the head of the screw. The latter is upset and turned down to fit. The screw should be of 1¾-inch steel, or larger, and on its upper end it carries a hand wheel by which the press is operated.

TO MAKE COTTON FROM PINE.

Process Discovered in Bavaria That May Make Europe Independent of America

Experiments are being made in Bavaria in the manufacture of cotton out of pine wood. The method is to reduce the wood to the finest layers possible, then to subject it to a vapor pressure for ten hours. The pulp is then plunged into a soda bath where it stays 36 hours. It is thus transformed into a kind of cellulose, to which a resistant quality is given by adding oil and gelatin. Then it is drawn out and untangled by machinery.

The process is said not to be expensive and it is thought if this cottom can be made of practical use, Europe will be independent of America and India. The immense forests of Scandinavia and Germany would furnish an abundance of material.

THE FIRE PAILS WERE HANDY.

Fire buckets are made with round bottoms to hang up and thus prevent their use for other purposes. The boys got around this by making a dent in the bottom so the pail would stand alone. To circumvent this a pail was made which tapered to a point. Then the boys cut a hole in a board and laid it across a box with the pail sticking into the hole. It is a bright one who can fool the boys.

The use of flour barrels has fallen off 40 per cent during the past 12 years. People purchase by the sack.

SPECIAL SUBSCRIPTION OFFER.

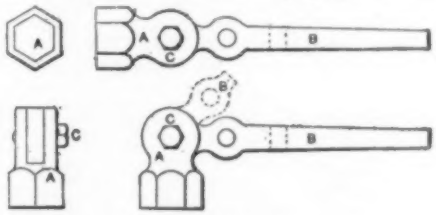
In response to numerous requests the publishers of Popular Mechanics announce a special subscription offer of five years for three dollars. Address may be changed as often as desired.

POPULAR MECHANICS' PREMIUMS.

Don't forget to send for Popular Mechanics' premium list. It is sure to interest you. It will tell how you can get many desirable and serviceable articles with little effort.

A SOCKET WRENCH.

A socket wrench with adjustable stem for use in awkward places is shown in the accompanying cut. By the use of a jointed stem, as shown, the wrench is made available for nuts in almost any position and,



SOCKET WRENCH.

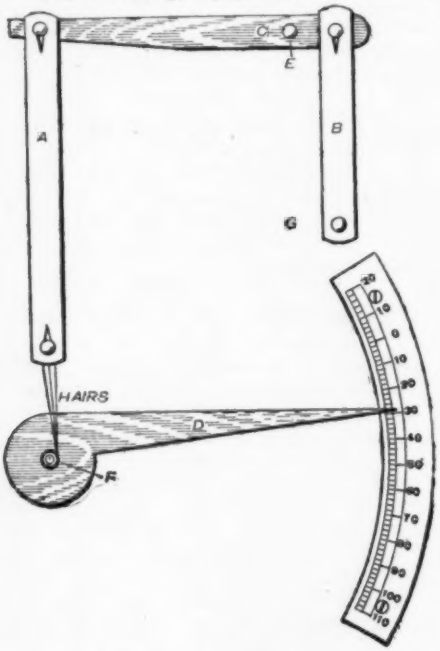
of course, will avoid marring any nut for which it is fitted by any slipping of the wrench. Sets of these wrenches may be made up with handles and sockets interchangeable, so that at slight expense they may be available for any size of nut. We are indebted to Machinery for the suggestion.

If you like Popular Mechanics please tell your friends about it.

HOW TO MAKE A CURIOUS THERMOMETER.

A thermometer which depends upon pieces of brown paper and a few horsehairs, instead of mercury or spirits, for its action, is certainly a curiosity, and cannot fail to attract attention and interest your mechanical friends. The Engineer tells how to make one.

The strips, A and B, are cut from thick brown wrapping paper, the coarser the better. Cut the strip, A, 1 inch wide and 30



A CURIOUS THERMOMETER.

inches long, and B, 1 inch wide and 20 inches long. Cut button-holes in the end of each strip as shown. The piece, C, is about 1 foot long, and is made of thin wood. The hole, E, is 4 inches from the wide end. The hand, D, is made of very thin light wood and tapers to a point at one end, a circle being formed at the other end to act as a counter weight. The principal thing to be remembered in connection with the pointer is to have the pointed end just heavy enough to overbalance the round end so that it will descend by its own weight.

A small circle of wood, F, is fastened with glue on the large end of the pointer to which the horsehairs are attached.

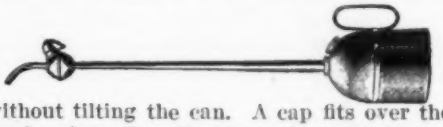
Select a place on the wall where you wish to locate the thermometer. Then first put up the lever, C, by driving a smooth wire nail, or a screw, through the hole, E. Button on strip, B, and with the lever, C, in a horizontal position put a tack or screw through the button hole, G, in the lower end of B. Now button on strip, A, to the other end of the lever, C. To the lower end of strip, A, attach three or four strands of the horsehair, bringing the strands down about 6 inches and fastening them to the under side of the small circle of wood, F, on the pointer, D. Then fasten the pointer, D, to the wall with smooth nail or screw, which is to be put through the center of the small circle, F. The lever, C, and the pointer, D, must work perfectly free and easy on the screws.

When it is cold the paper and horsehairs will contract and the pointer will rise, and when it is warm the hair and paper will expand and the pointer will descend. A scale should be made, and degree marks laid off by marking the position of the pointer corresponding to the indications of a mercury thermometer.

You will notice that this thermometer works diametrically opposite to the mercury thermometer, the pointer descending with rising temperature, and rising with falling temperature. A very slight expansion or contraction of the paper and hair will move pointer a considerable distance.

COMBINED OILER AND TORCH.

A combined oiler and torch is something which will be appreciated by many engineers. The torch receives its fuel from the body of the can and will burn 30 minutes



without tilting the can. A cap fits over the torch when the oiler is to be used in the daytime. The combination leaves one hand free, as well as lighting the part to be oiled.

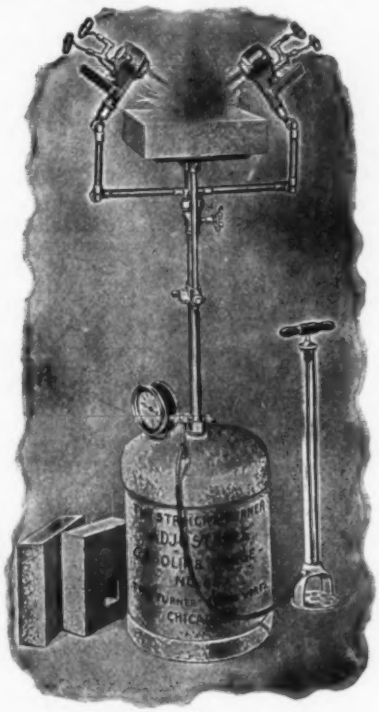
BOILING KETTLES WITHOUT COALS.

Every day in London scores of workmen's kettles are boiled in lime that will afterwards be used for its proper purpose. Just before the breakfast hour, say, one of the workmen empties a quantity of the dry lime from a sack. In the center of this lime he makes a hole, and into it water is poured. Then he puts his kettles into the water, and in a few minutes the kettles boil. In thousands of cases a fire is thus spared.

ADJUSTABLE BRAZING FORGE.

A new adjustable brazing forge is fitted with extra powerful double jet burners mounted on a compound swivel, in such a manner as to enable the operator to place the burners in any position, making this forge adjustable to all kinds of work.

The double jet burners generate a temperature of over 3,000 degrees F., which is a much higher temperature than is produced



Two-Jet Burner Brazing Forge

by any single jet burners, due to the fact that both air and gas are fed through the two jets and burned in the combustion chamber, so as to produce the maximum degree of heat from the fuel. The supply tank is made of boiler steel, strongly riveted and heavily galvanized, and each brazier is tested at a pressure of 150 pounds before shipping. This forge is specially desirable in brazing tubular axles and other work in automobile construction, and the adjustable features render it excellent for brazing large pieces of cast iron, brass, and other metals, as well as for general forge and shop work.

Any boy can own a watch if he wants to. Write to Popular Mechanics and learn how.

HINTS TO INVENTORS.

There are now 22,000 rural letter carriers in this country. Each of these routes has from 100 to 150 families. In many cases the farm house is some distance back from the road. The carrier, who rides in a covered wagon fitted up with boxes like a post-office is not required to deliver the mail to the house. A letter box must be placed at the side of the road. This compels the farmer to come out to the box when he wants his mail. Some good, simple, inexpensive system by which the letter box can be pulled along a wire by a person standing at the house is likely to meet with a large sale.

BATTERIES IN SERIES.

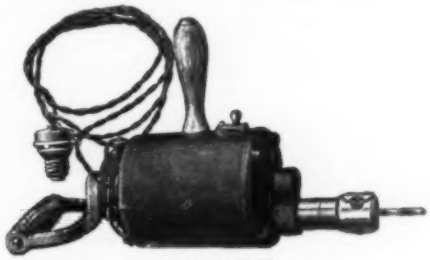
T. L. C. asks how to connect several batteries in series. Connect the zinc of one cell to the copper of the next, and so on.

WORTH A "DOLLAR A ONE."

An enthusiastic reader of this magazine in a large works in Cleveland, writes: "I would almost rather have my pay stopped than my Popular Mechanics. To me it is worth a dollar a copy."

ELECTRIC HAND DRILL.

One of the latest things in portable drills is the electric hand drill. It operates at 110 and 220 volts direct current, and can be operated in series with lamps on a railway



Electric Drill

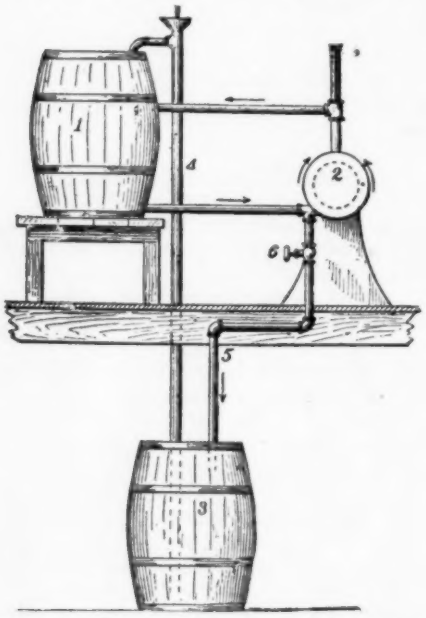
circuit, 500 volts. Current is secured by plugging the drill terminal into the socket of an ordinary incandescent lamp circuit. The drill can be used on both wood and metal work.

Send for our new premium list. We have offers that will surprise you. Everything from engines to watches.

A GASOLINE ENGINE KINK.

The problem of keeping a gasoline engine cool in cold weather and still avoiding frozen pipes or a bursted water jacket has been solved very satisfactorily by a writer in the Blacksmith and Wheelwright. The accompanying cut illustrates the arrangement used.

Two barrels and some piping are all that is required, one barrel being placed on a



bench on a level with the cylinder of the engine, and the other one below the freezing line, as shown. The figures indicate, 1—barrel for water; 2—cylinder of engine; 3—barrel for water below; 4—pump to raise water to upper barrel; 5—pipe that lets water in barrel below when done work, by turning valve 6. The pump is operated from the engine and when barrel 1 is full can be thrown out of gear.

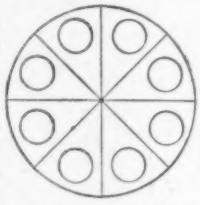
COPPER WIRE FOR HOT BEARINGS.

An ingenious remedy for a bearing which ran hot and burned out every three weeks is described in the Woodworker. The bearing was one of three on a band saw machine. The writer says: I cut out all the old babbit metal, then got some copper wire ⅛ inch diameter and bent it in zigzag shape till I got enough bent to go the length of the bearing; laid it in the box, put the shaft in place and poured the hot babbit metal the same as though the wire was not there. The idea I had was to have the shaft bear on the copper as well as the babbit, and I succeeded.

HOW TO MAKE EVERY FURNACE PIPE HEAT.

Where there is sufficient height in the furnace room, every pipe leading to a register may be made to carry heat. The method is described by a writer in the Metal Worker, who says:

I put up a hot air furnace 42 inches in diameter and having eight pipes on it. The customer complained of two rooms not heating that were fed by pipes on opposite sides of the furnace. To overcome this trouble I resorted to an expedient that would have been impossible in a low cellar, but the furnace was in a cellar having a 12-foot ceiling. I took off the top and raised the casing 18 inches, finishing it with a flat top with a 3-inch rim around it to hold sand, and put the eight pipes in the top, running off with three-piece elbows. I put a partition in between each of the pipes, extending down to 18 inches. A plan of the under side of the top is shown herewith. This practically makes eight separate heaters over one fire, for all of the air that rises in the furnace between any pair of these partitions can only escape through the pipe from that space. The finished job gave entire satisfaction.



HOW TO MAKE A HECTOGRAPH.

A formula for making a hectograph, or composition for taking duplicate copies from one original copy written with aniline ink, is as follows: 100 parts white glue; 500 parts glycerine; 25 parts sulphate of baryta (kaolin); 375 parts of water. Soak the glue in the water until dissolved; then add the glycerine and kaolin, and cook slowly until thoroughly dissolved and smooth. Add a few drops of carbolic acid; pour the mixture into a pan and clean all scum and bubbles off the top; then set to cool. Trouble is sometimes experienced with this formula, probably because of difference in the quality of the glue or the glycerine; but, under favorable conditions, it makes a thoroughly good hectograph.

BORING AN ENGINE CYLINDER.

A 10 or 12-horsepower stationary engine cylinder may be bored on a 24-inch lathe even if you are not supplied with cast iron brackets and adjusting screws, says the Blacksmith and Wheelwright.

Get four good seasoned oak pieces, A, long enough to reach across the lathe carriage. Bore holes for the bolts, which

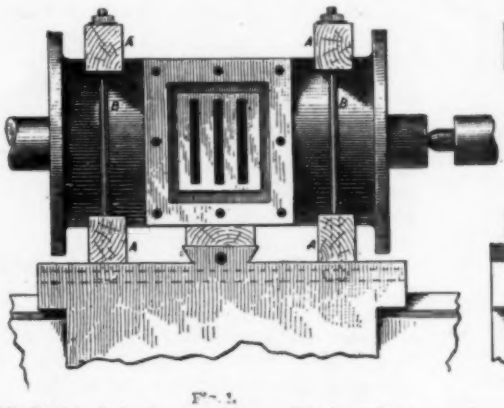


Fig. 1.

should fit T slots in carriage. Find radius outside diameter of the cylinder. Lay blocks in carriage. Take pair of dividers, set to radius of cylinders and scribe from lathe center on blocks and cut out as per dotted line in Fig. 2. Get four ⅝ or ¾-inch bolts, B, long enough to allow nuts to have a full thread after top clamp is on, as in sketch. Next place bar through cylinder and between lathe centers; put tool in bar; tighten it just enough to hold it in place; true cylinder by counter lines, on each end turning bar by hand. If too low when tightened down, loosen up and raise with pasteboard under blocks on carriage. After getting cylinder perfectly true set tool to take just enough out to true inside by taking a ruffing cut and finishing cut. Run lathe on slow speed, and feed just fine enough to make a smooth job. Never stop lathe while taking the finishing cut.

Make tool as at C, Fig. 2, of ⅝-inch round steel to suit diameter of cylinder. Give it just enough clearance to clear cylinder wall on point. Use good judgment in tightening clamps on cylinder. If too tight they will spring out of round.

What becomes of the 100,000,000 tooth picks manufactured daily in this country? Let the lodging house fellow, the loafer and the kindergartner answer.

RECIPES FOR POLISHING PASTE.

Good receipes for polishing pastes are the following:

1. 5 pounds lard or yellow vaseline melted and mixed with 1 pound fine rouge.

2. 2 pounds palm oil and 2 pounds vaseline melted together, and then 1 pound rouge, ½ pound tripoli and 1 ounce oxalic acid are stirred in.

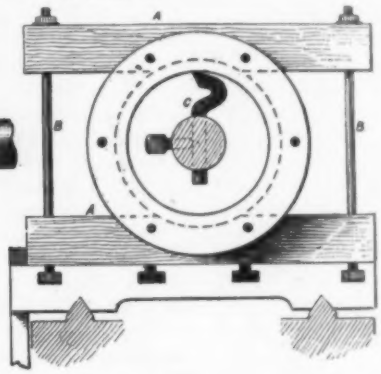


Fig. 2.

3. 4 pounds vaseline, 2 pounds oleic acid and 1 pound tripoli and sufficient kieselguhr mixed together to form a paste of suitable consistence.

4. 4 pounds vaseline and 1 pound lard, melted and mixed with 1 pound rouge.

The polishing pomades are generally perfumed with essence of mirbane and filled into tin boxes.

Polishing powders are advantageously prepared according to the following recipes:

1. 4 pounds magnesium carbonate, 4 pounds chalk and 4 pounds rouge intimately mixed.

2. 4 pounds magnesium carbonate, mixed with ¼ pound fine rouge.

3. 5 pounds fine levigated whiting and 2 pounds Venetian red ground together.

POPULATION OF CHINA.

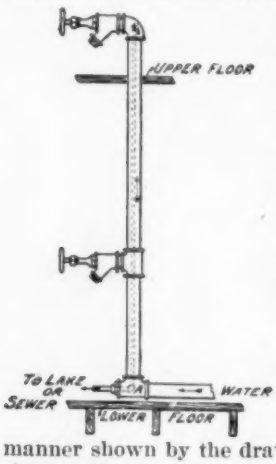
The last census taken of China places her total population at 426,447,325 inhabitants, distributed as follows: Eighteen Chinese provinces, 407,737,305; Manchuria, 8,500,000; Mongolia, 3,354,000; Tibet, 6,430,000; Chinese Turkestan, 426,000.

Will you not send us the name of at least one acquaintance whom you think might be interested in Popular Mechanics?

NON-FREEZING STAND PIPE.

Fire fighting in cold weather is always difficult, but when the water supply is allowed to freeze, what ordinarily would be only an incipient blaze often results in the complete destruction of the plant.

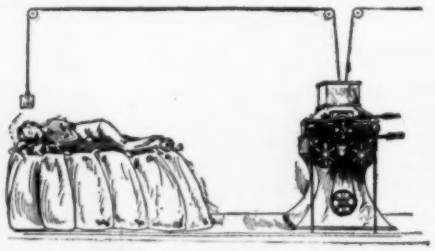
In mills that are equipped with stand pipes it sometimes happens that the building will be without heat for some time from one cause or another. At the same time it is imperative that the water supply in the stand pipes be maintained as usual, to be available in case of necessity.



An ingenious correspondent to Steam Engineering overcame the difficulty in the manner shown by the drawing. In this case the stand pipe was a 2-inch pipe with hydrants. The only change was at A, where an elbow was removed and a tee with a bushing for a ¼-inch pipe substituted. A valve was put on this ¼-inch pipe to regulate the flow. By allowing a constant small waste, it was possible to keep water in the stand pipe and still prevent it freezing.

FEED ALARM FOR SLEEPY MILLERS.

The accompanying wrinkle comes anonymously from Seneca Falls, N. Y.: It requires no explanation. The flow of the feed in the feed hopper, by gravity, causes a dingus, provided with an eccentric, to revolve. When the feed ceases, the dingus



stops revolving, the eccentric slips and a ten-pound weight drops on the head of the sleeping miller. This will cause the miller to awake. If it does not, the weight should be increased. The dingus can be made of any metallic substance. The miller should be of combustible material so that he can be fired.

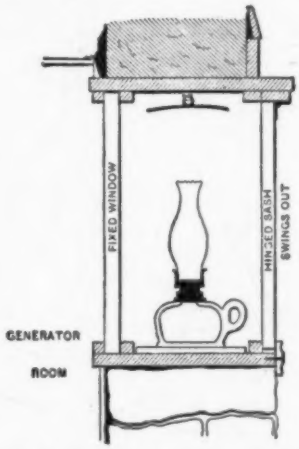
IMPROVEMENT IN BOBSLEDS.

An improvement in bob-sleds has recently been patented by a Minnesota man. Each runner is hung loose on an axle which per-

mits any one of the four runners to pass over obstructions with less strain and jar to the pair of runners.

DEVICE TO PREVENT EXPLOSIONS OF ACETYLENE.

Under no circumstances should an artificial light be taken into the room where the acetylene generators are placed. Many of the terrible explosions which have blown



stores and houses into fragments, like a charge of dynamite, have been caused by the careless striking of a match or the taking of a lighted lamp into the generating room. An article in the Acetylene Journal urges great precautions in this respect and tells how to light the room. Small windows should be placed to allow daylight to enter, and at night a lamp placed in a box outside the room can be used with safety.

Popular Mechanics "is written so you can understand it."

Lathe Attachments

Copyrighted 1904 by W. W. Wood.

Part I. General Introduction and Description of Division Plate and Pointer,
Part II. Overhead for Lathe and Alternate Form of Same.
Part III. Milling Attachment for Rotary Cutters.
Part IV. Milling and Drilling Spindle,
Part V. Gear Wheels and Rotary Cutters,
Part VI. Suggestions on Changing Plain Lathe to Self-Acting and Screw-Cutting Lathe.

MILLING ATTACHMENT FOR ROTARY CUTTERS.

Having occasion to make some small gears I designed and built the milling attachment as shown in Figs. 1, 2 and 3, and which is secured to the slide rest of lathe by means of a small bar of iron which goes through the slot in tool post and over the two lugs, a and a', Fig. 3, and is clamped down by the screw in tool post.

Fig. 1 is a side elevation showing spindle with driving pulley and a gear cutter in place and portion of belt from overhead.

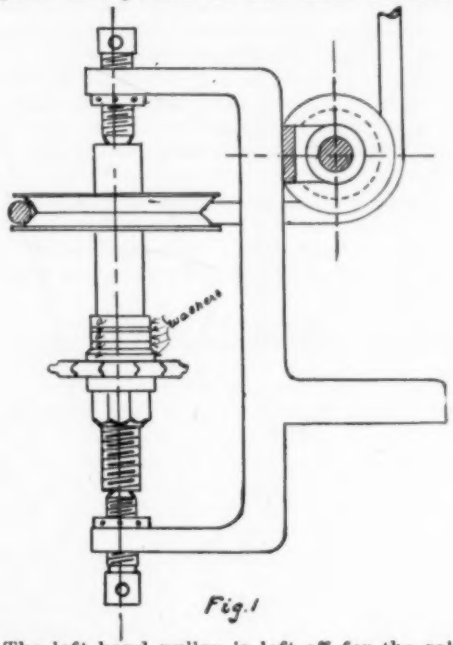


Fig. 1

The left hand pulley is left off for the sake of clearness.

Fig. 2 shows a rear elevation and Fig. 3 is a plan or view of the attachment from directly over it.

A wooden pattern is made for the frame which is to be of cast iron. Also a pattern for pulleys and their supports which are cast in brass.

When the castings are procured, proceed to dress the casting for frame, taking pains to get the holding-down lugs perfectly square and at right angles with the frame. Then drill and tap the holes for the bearing screws between which the spindle revolves, being very careful to get them straight with each other and the frame. Next file up the casting for the pulley supports, drill and tap the holes for screwing in the spindles and fasten onto frame by means of two short screws as shown in Fig. 2. Now turn up the spindles from a piece of steel as shown at Fig. 3, screwing one end externally to fit the tapped holes in the supports and drilling and tapping the other end internally to receive the flat headed screw, at Fig. 3, which holds the pulley in place. Another way to secure the pulley on the spindle is to extend the spindle and thread it externally as at opposite end, leaving a slight shoulder and using a nut and washer. Now, make the spindle, as shown in Fig. 1, leaving a shoulder which the washers, shown at Fig. 1, will fit up against and thread the other end to take nut and washer, which, when screwed up tight, holds the milling cutter in place. The several turned wash-

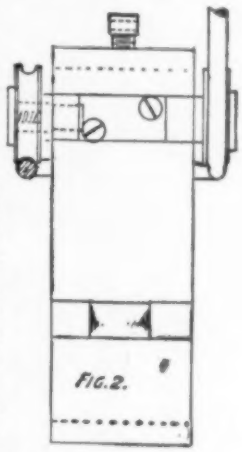
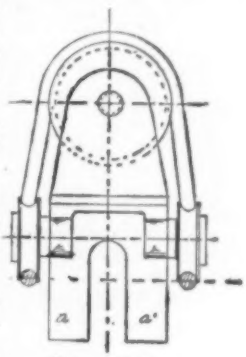
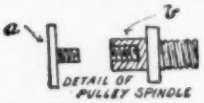


Fig. 2.



Plan. Fig 3.

ers are used for adjustment and further adjustment can be made by the bearing screws at each end. The driving pulley on spindle is secured either by a grub screw or keyed to the spindle. To make the bearing centers in spindle first, drill a hole about ½ in. deep using a small drill, and then open out with a countersink of same angle as the tapered end of bearing screws. Both the ends of the screws and the spindle should be case hardened. This can be accomplished by heating them to bright red and rolling them in some powdered cyanide of potash, cooling out in water. Be careful not to inhale the fumes or get cyanide on the hands, as it is deadly poison. Tommy holes should be drilled through the heads of bearing screws and also in the edge of threaded washers which are used as lock nuts to keep screws from coming out or turning when the spindle is in motion.



The cutter is made from a piece of steel and is turned up so that the edge is of the exact section of the cut to be made as, for instance, a gear tooth, and then divided into ten or more parts and teeth filed, making it into a kind of circular saw. To cut a gear, the blank is held on a mandrel between lathe centers. The milling frame is mounted on the slide rest and cutter adjusted so the center line of cutter is on a line with centers of lathe. The division plate is used to space the gear blank. When everything is in place start the lathe, using the belt from the over-head to drive the cutter. Advance the cutter to work by means of the cross slide and make the cut by means of the other slide. When one cut is finished turn the blank for the next cut, counting off the number of holes in the division plate. Make the cut and proceed as before until teeth are all cut. More detailed information regarding cutters and gears will be given in a future article. The next will be on a milling and drilling spindle for ornamental work, etc.

THAWING SERVICE WATER PIPES BY ELECTRICITY.

No more digging up the frozen pavement to thaw out water pipes. An electric current taken from the street railway trolley line or lighting socket in the house or store will do the work, surely, safely and in 15 minutes. The past winter has been unusually severe on the service pipes leading from the street into buildings and scores of consumers all over the country have been out of water for days at a time.

The electric method was discovered several years ago by an electrician in Madison, Wis., and the wonder is the plan has not been universally adopted. Nearly all towns which have water works have also an electric light system. The thawing is done as follows: One electrician and two unskilled assistants. Connection is first made by means of an insulated wire to the source of current, which is passed through a transformer. The transformer reduces the intensity of the railway current, and increases that of the incandescent service. From the transformer a wire connects to some faucet in the house.

Another wire is run, connecting the nearest fire plug to the return circuit of the trolley line or lighting system. This establishes a current through the frozen pipe which is heated and melts the ice contained in the pipe. A considerable amount of current is required, but the expense by this method is usually about half what it costs to open a trench and thaw with steam boilers, while the time consumed is very small, the pavement is undisturbed and no litter made.

Those of our readers interested in plumbing business or work, who have not already equipped their shops for electric thawing, will find it profitable to do so in good season for next winter.

HOW TO RENDER CLOTHES FIREPROOF.

The light, fluffy garments of children, as well as the heavier textures worn by adults, can be rendered fireproof, or at least to an extent in which they will not readily ignite. The method is simple and inexpensive, and the chemical used can be purchased for a few cents at any drug store.

Dr. Doremus, a celebrated chemist, tells how to do it: "After the heart-rending loss of a young son, whose summer dress took fire from a candle flame, I made a thorough search among chemical agents to determine which would most effectively render dresses non-inflammable. None equaled ammonium phosphate. Each time the underclothing and dresses of my children were washed this chemical was added to the starch solution, which rendered them flame proof. For forty years I have urged the employment of chemical agents to save life, but the apathy of the public surpasses belief."

GOVERNMENT PRINTING OFFICE WAKES UP.

Adoption of Typesetting Machines at Last Being Considered—Means Enormous Saving

At last the government printing office at Washington is considering the adoption of typesetting machines with which the work of that mammoth institution may be done nearly 40 per cent cheaper than it is now done by hand composition. Although these machines have long since been established in the smallest newspaper offices in the United States and have long been regarded as a necessity by them, the United States government has been content to mope along with an antiquated method of typesetting that the most insignificant country daily would have held to ridicule. The excuse of the government for its Chinese-like lethargy is that labor unions would oppose the installation of such an improvement that would save the government thousands of dollars but throw a number of men out of work.

Labor leaders of the size of Mitchell and Gompers have all many times declared that reputable labor bodies of America do not oppose the introduction of labor-saving devices and that such opposition is inexpedient and unwise.

This disposition of the government to adhere to antiquated methods is not characteristic of the past. The printing office did not retain the old flat-bed hand press after the cylinder press was invented; it did not insist in carrying mail by the old stage coach when the railroad and mail cars came into use; it did not oppose the introduction of electric stamping machines used in cancellation—yet all of these, as are all acceptable inventions, were great labor savers. As a matter of fact the introduction of the railway mail car has so vastly improved and cheapened the service that it has enabled the handling of thousands of tons more mail at greatly reduced postage and thus given employment to thousands more men than would be required under the old mail stage coach.

TO POLISH BRASS.

Smooth brass with a fine file; rub with a smooth fine grain stone, or with charcoal and water. When quite smooth, polish with rotten stone and oil, spirits of turpentine, or alcohol.

REMARKABLE FIRE PHOTOGRAPH.

Picture of Baltimore Conflagration Taken by the Light of the Flames

A remarkable photograph of the Baltimore fire, taken by the light of the fire, while the conflagration raged, has been received by Popular Mechanics. The picture was taken at a time when the fire was making its way into the heart of the city and

Photograph of Burning Baltimore Taken by the Light of the Fire

feeding on the skyscrapers, just before building after building was blown up with dynamite in a vain effort to cut off the flames. The scene is different from that in the Chicago fire of 1871, when the people instead of standing about were running for their lives to avoid being overtaken by the flames which were sweeping over the city with such phenomenal speed. The photo is by Purcell.

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HISTORY'S GREATEST RAILWAY PROJECT

In the Grand Trunk Extension England's Dream of 500 Years is Being Realized

In the construction of the Canadian Trans-Continental railway Britain's dream of 500 years is being realized. Success of the project is now assured, due to the efforts of Sir Charles Rivers Wilson and C. M. Hays. Plans for the construction of the Grand Trunk Pacific railway to extend from North Bay or Gravenhurst, Ont., to either Butte Inlet or Port Simpson, a distance of 3,025 miles, have been approved by the stockholders and directors of the Grand Trunk railway. The Canadian government has agreed to construct a portion of the road and guarantee the bonds to be issued for the remaining portion.

This undertaking outranks any single railway project in history with the possible exception of the Trans-Siberian railway. But this road will be of equipment far superior to the Trans-Siberian road. The total cost will reach the enormous figure of $125,000,000. The road will afford the shortest route to the Orient from Liverpool, from the large centers of Canada, from New York and the manufacturing centers of the East and an equal route to the Orient from Chicago and the Middle West. It will be the lowest grade mountain line on the continent and will give 7,200 miles of continuous railway with steamship connections, over which rates can be made to every part of the world without consultation with friendly or unfriendly connections.

The Eastern states will be reached by the Central Vermont of the Grand Trunk system; the gateways of Chicago, Detroit and Port Huron by the Grand Trunk Western, both roads to make short connections with the Trans-Continental railway.

From New York to Yokohama, by way of Montreal, the distance over the new line will be 418 miles shorter than by the Canadian Pacific, 555 miles shorter than by Chicago and San Francisco and 1,800 miles shorter than by Galveston and San Francisco. From Liverpool to Yokohama by way of Quebec the distance will be 528 miles shorter than by the Canadian Pacific, 1,313 miles shorter than by New York and San Francisco and 130 miles shorter than by Moscow and the Trans-Siberian railway. From Chicago and Milwaukee to Yokohama by the Grand Trunk will be 535 miles longer than by the short route via St. Paul and the Canadian Pacific, but shorter in time, and will be 265 miles shorter than by St. Paul and Winnipeg.

This road will add millions to the wealth of Canada in increasing its Oriental trade. Canadian exports to the Orient increased from $93,827,077 in 1890 to $211,640,286 in 1902. In the United States the increase was from $151,100,000 to $433,850,000. Along the lines of the Grand Trunk there are located 45 cities and towns of more than 4,000 inhabitants each and aggregating 1,000,940, which is 18.7 per cent of Canada's population. From these towns the bulk of manufactured articles are now shipped to the Northwest and exported.

The line will penetrate the vast area of unoccupied fertile land of northwestern Canada. These lands amount to 500,000,000 acres, which are equal to five-eighths of the total farm area of the United States. Of the 15,400,000 acres of occupied land there, only 6,000,000 acres are under cultivation. These 6,000,000 acres in 1902 produced 60,000,000 bushels of wheat. The unoccupied lands are said to be capable of producing three billion bushels of wheat annually, or a production five times greater than the total United States crop of 1900.

MACHINE TO SPLIT WOOD.

A Spokane man has invented a machine capable of splitting wood 2 feet long and 18 inches thick. The machine is run by a three horse power gasoline engine and consists of a huge knife working through the knottiest wood at the rate of 60 strokes per minute. A contrivance to carry off the wood is to be added to the machine.

IROQUOIS CURTAIN EXONERATED.

New Facts Tend to Show Its Condemnation Was Unjust und That It Was Really Fireproof

After the excitement and indignation, resulting from the Iroquois fire, has subsided, a clear and cool observation of the causes that led to the wholesale destruction of life, tends to exonerate the now famous asbestos curtain from the charges that were brought against it. The curtain, it is now believed, withstood the flames remarkably well and its partial destruction was caused by the deluge of water thrown against it when hot, and the axes of the firemen, and by being frozen over and trampled under foot after it had fallen. It is proved beyond doubt that the curtain caught on some obstruction when an attempt was made to let it down and that it was never lowered.

Mr. George W. Stetson, Secretary of the C. W. Trainer Manufacturing Company, which made the Iroquois curtain, explained before the Grand Jury that it was necessary in order to weave asbestos to mix with it a small amount of cotton, say, three or five per cent, not three parts cotton as has been charged.

He also testified, "We manufacture one grade, but two kinds. One kind consists of what is known as pure asbestos cloth. The other kind consists of the same cloth with a wire insertion. The only difference in the nature of the curtains is that the one with the wire insertion has greater textile strength."

Mr. Stetson on his return to Boston, the home of the manufacturer, made this statement:

"The writer has just returned from Chicago after making a careful examination of the stage of the Iroquois theatre and to dispel any doubts that may be entertained as to the fireproof qualities of the asbestos curtain used there, or rather the asbestos curtain which the testimony before Coroner Traeger seems to show conclusively was not used, begs to submit the following facts:

"First—Large portions of the asbestos curtain were found lying across the stage extending from one side of the proscenium arch to the other. The curtain apparently hung suspended above the arch and remained there until the fire burned away its supports, when it dropped to the stage, falling almost underneath the point from which it was hung. It must have been heated to a very high temperature by the intense fire surrounding it, and as soon as it fell was deluged by water from the firemen's hose. This is shown conclusively from the fact that in order to recover portions of it, they had to be chopped out with a hatchet, as the whole mass was frozen solid. Even after such usage as this, which no mineral would stand without disintegration, the pieces of curtain imbedded part way through the mass and which were protected while hot, to some extent, from the water, were found to have retained their tensile strength and pliability. This is an excellent proof of the quality and strength of the asbestos curtain. We have in our possession a piece of the asbestos curtain brought back by the writer which may be seen at our office in substantiation of our claims.

"Second—The inquest has shown that when the fire started in the drops, the asbestos curtain was called for, but apparently a mistake was made and the "act drop" was lowered instead. This, of course, burned and the public, through statements credited to prominent persons, was led to believe that the asbestos curtain burned. Superficial examination shows that pieces of "burlap backed" screens had been picked up and as they were painted with a mineral composition, hasty conclusions were drawn that these were pieces of the asbestos curtain. Meanwhile the asbestos curtain was covered with debris and was being trampled under foot by the curious.

"Third—There is little doubt that had the asbestos curtain been lowered, it would have acted as a damper, preventing the great draught of air from the auditorium from forcing the flames up through and among the drops, and would have thus temporarily held back and partially checked their spread. The audience, no doubt, had faith in the asbestos curtain, for testimony shows that they kept their seats until they saw a burning curtain lowered; and the awful panic followed. There is no doubt that the sight of what they supposed was the asbestos curtain in flames, brought terror with it. Can we not draw the following conclusions:

"Firstly, that the asbestos curtain was of a high grade asbestos material and thoroughly substantial?

"Secondly, that the asbestos curtain was not lowered?

"Thirdly, that had it been lowered, immediately, the progress of the fire would have been temporarily checked?

"Fourthly, that had it been lowered, the audience would have felt secure, a panic would have been averted and the patrons would have left the theatre without confusion?

"Fifthly, that it is safe to say 571 lives would not have been lost?"

Doubtless we can safely say so and the better the facts are known the greater will be the proof that a real asbestos curtain will not burn.

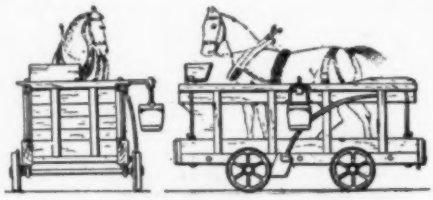
The erroneous reports made regarding the Iroquois curtain are probably responsible for the fact that no asbestos curtains are to be used in any of the Chicago theatres. The new ordinance drafted and passed after the Iroquois fire, requires the use of steel curtains instead of asbestos. This, however, is all the result of hasty and publicly enforced legislation, and the groundless prejudice in Chicago against asbestos will doubtless wear away when it becomes universally known that the Iroquois curtain was never burned and has been unjustly condemned.

PHOTOGRAPHING FISH FROM LIFE.

Photographs showing fish swimming about in their natural element are a new acquisition to science made possible by recent inventions in photography. The photograph from which the accompanying picture is obtained was made direct from life while the fish was swimming in a tank. The fish passed directly across the plate giving the severest test for speed. The curtain slide shutter, which will make a picture with 1-1000 part of a second's exposure was used in the snapshot. The negative was made with an anastigmat lens.

WHEN HORSES RODE.

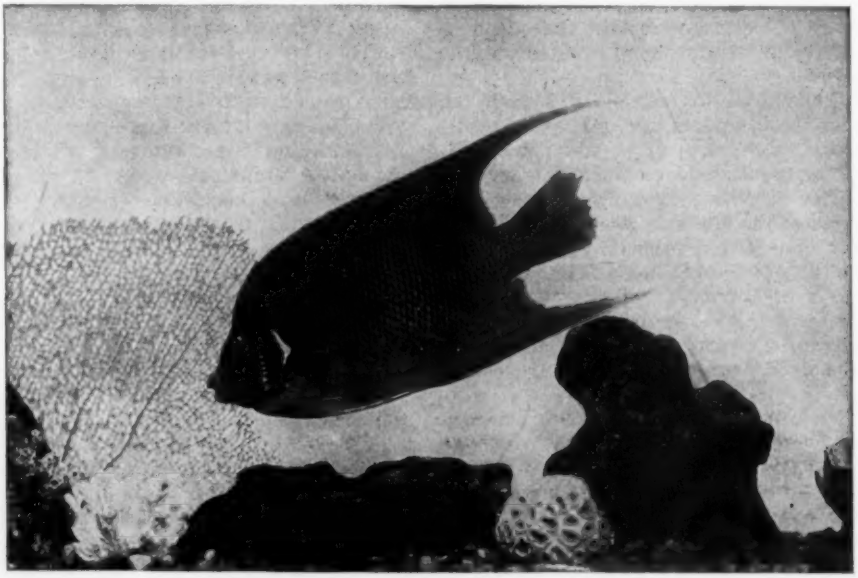
There was a period in the development of transportation facilities when horses rode. A train of cars was followed by a



Dandy Cart

low truck, termed a "Dandy Cart," in which the horse rode down the inclines, gravity being the motive force. The cars ran over roads built for that purpose and were used for hauling coal from mines, the horse going along to draw back the empty cars.

The Railroad Gazette says the Dandy Cart came into use about 1827.



Fish Photographed While Swimming

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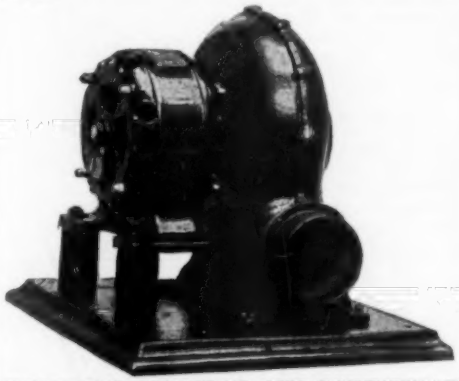

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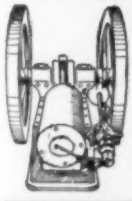

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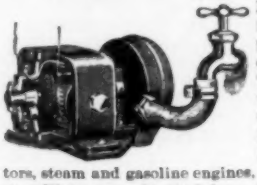

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THE HERO OF THE TRAIN.

Written for Popular Mechanics by George R. Harrison.

Called from the peace of his slumber,
Called from the deep of a dream,
Called from the hour of his comfort,
Where fondness is reigning supreme.
A lingered caress for a darling,
A kiss for a drowsy one's lips,
A hurried good-bye at the doorway,
And into the darkness he slips.

Into the glare of the roundhouse,
Greeting his comrades of men,
Climbing the steps to the engine,
And gripping the throttle again;
Creeping away to the country,
By slumber-still meadows and vales,
Watching the gleam of the headlight,
That travels the musical rails.

Gloom looking out of the heavens,
Gloom to the left and the right;
Gloom trailing after the rattle,
And gloom just ahead of the light.
Danger is haunting the bridges,
And danger is lurking the curves,
But bravely he keeps his position—
So nobly his duty he serves.

Proud as a conquering warrior,
When laurels of battles are won,
He rides, looking constantly forward,
Till reaching the end of the run.
A bite and a drink at a counter,
A craving for sleep all in vain,
Followed again by a "call-boy,"
With an order of "Back to the train."

Back again over the country,
By woodlands all kissed with the light;
The blossoms all beck in the breezes
To signal him on in his flight.
The green of the grass is a dazzle,
The telegraph poles glimmer by;
He sings to his mate "Feed 'er faster!"—
She belches her smoke to the sky.

Home again, man of the railroad!
Back with the ones that impart
A welcome of love and laughter,
And music that lightens the heart.
Bask in the joy while you linger,
For duty, perhaps, is your doom;
Fate may be waiting to grasp you
And roll you away to the tomb.

The world rushes on with its rabble—
The nations trump not of his fame;
Tho' his breast is not blazoned with badges,
We know he's a hero the same!
Let others sing songs of the soldier,
Or the lad of the billowy main,
But while they are singing we'll echo
A song for the main of the train.

RODE A KITE 1600 FEET IN AIR.

With a telephone apparatus hanging from his shoulders, and paying out its long coil as he went, S. F. Cody, who conducted some kite-flying experiments at Alexandria Park, ascended by kite 1600 feet and from this height conversed with inhabitants of this nether world.

In the ascent the entire 2000 feet of cable was used, the man-carriers being 1600 feet above the earth and the pilot kite 1000 feet higher yet. In previous ascents 1200 feet is the greatest height attained.

Korea's concession to Russia that she might cut timber in the Yalu valley is said to have started the trouble between Russia and Japan.

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HOW TO KNOW WHEN A PERSON IS DEAD.

Of all the things most to be dreaded is that of being buried alive. There can be no possibility of such a thing if the following directions given by Dr. J. D. Johnson, an eminent physician of Philadelphia, are followed. His directions are so simple they will be readily understood.

In all cases of apparent death occurring suddenly, or from external violence, and whenever there is any doubt in the matter, extraordinary precautions should be taken in order to settle the question. The cessation of respiration and circulation (so far as can be observed) does not determine the matter, and even the absence of animal heat is not conclusive, for life may exist and recovery take place where this is not an attendant. In all doubtful cases the following tests should be applied:

Put the body in a dark room, place the hand (with fingers close together) between the eye and a lighted candle; if life is not extinct, hand will show transparent redness as in life.

Tie a cord tightly around a finger; if the end becomes swollen and red life is not extinct.

Inject a few drops of aqua ammonia under the skin; if life still exists a red or purple spot will form.

Insert a bright steel needle into the flesh; allow it to remain half an hour; if life is extinct it will tarnish by oxidation.

Place the surface of a cold mirror over the mouth; if moisture condenses on the surface respiration has not ceased.

In from 12 to 18 hours after death eye-balls become soft, inelastic, feel flaccid.

In from 8 to 12 hours after death hypostasis or congestion of blood in capillaries begins to form in all depending parts of the body.

Putrefaction is positive proof of death, and unless this takes place by the end of the third day, interment should be postponed until it does.

While it is a fact that there is no machine or device in use improvements of which could not be profitable, there are many kinds of appliances that specially need to be improved and the successful inventors of such improvements will reap quick and ample returns. In wooden ware there is a demand for improved step-ladders, ironing boards, curtain stretchers, kitchen cabinets, benches. In metal ware for use in the household, there is ample room for improvements in cooking utensils, including pans, strainers, graters, lids, lifters, etc. In building material there has been great advances in the last two years in the making of bricks, building blocks, shingles and other forms required in the construction of buildings, out of cement, terra cotta and other fireproof compositions, and also in the construction of metal windows, window frames, doors, stairways. Sheet metal is being substituted for wood in the manufacture of furniture and all kinds of office appliances, and the field for improvements in these lines, whereby the article is made more ornamental or stronger or more durable, is almost limitless.

The use of sheet metal in the construction of railroad cars is being greatly extended and some of the wealthiest men, such as Cornelius Vanderbilt, and large corporations, are devoting money and brains to the perfection of metallic construction in railway appliances of all kinds. The production of metal is now so extensive and cheap that it is found to be more economical than wood, and its durability is very much greater. The extension of mail facilities to the countryside has opened a great field for new devices in transmitting and delivering mail, and at the present rate of progress it will be but a short time when the farmer will have his mail delivered as promptly and as conveniently as the resident of a town or city.

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PATENT NOTES.

A patent was recently issued to John McTammany, of Massachusetts, on a vote-counting machine. This is probably an improvement on the Tammany vote-counting machine of New York, but we doubt if it will prove as popular.

During the year 1903, 31,699 patents were granted by the United States, of which 3,763 were issued to citizens of foreign countries. Illinois inventors obtained 2,811 patents or one to every 1,715 residents of the state. One man out of every 997 residents of Connecticut obtained a patent. To residents of Massachusetts, 2,081 patents were issued, which is one to every 1,348 of that state. The number of patents is gradually increasing and the records of the Patent Office show that a larger proportion than ever are bought by manufacturing concerns and others who believe in patent rights as an investment. There is no bureau of the government in which such important work is transacted with so great fidelity as the Patent Office. Employes whose salaries range from $600 to $2,400 a year are intrusted with the care of inventions, the value of which is frequently in the millions, but notwithstanding the opportunity to take advantage of this information there never has been an instance in which a Patent Office employe has betrayed the special trust reposed in him. The notion that prevails among some inventors that they take risks in submitting their ideas to the scrutiny of the Patent Office Examiners, is wholly without foundation or reason. The law prohibits an employe of the Patent Office from taking out a patent on any invention the application for which was pending while he was in the Patent Office. Inventors have everything to gain and nothing to lose by filing their applications for patents in the Patent Office.

The successful inventor is the one who looks about him and takes note of the things that are popular and studies them with a view of finding where and how they can be made better or cheaper, or changed so as to increase their function or usefulness. Having hit upon or worked out what he thinks is an improvement, the first step is to find out whether it can be protected by a patent. Having found that a patent can be obtained he loses no time in making an application for a patent and goes to work at once to manufacture and put on the market the article, or to find some manufacturer or other person to join him in doing so.

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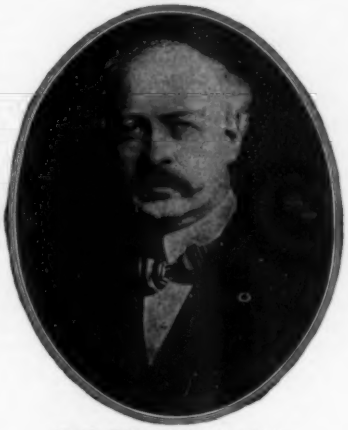

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A NEW METHOD OF COLORING PHOTOGRAPHS.

The following method of coloring photographs will give anything from good to best depending on the ability or patience of the operator, even the first attempt resulting in a charming picture, says a writer in the American Amateur Photographer. From a good negative, the simpler the subject the better, print on a piece of rollable film exactly as for a lantern slide; one or two trials will show to just what density the positive should be. Eastman's "N C" film answers admirably. Select a suitable backing paper of any delicate shade, although for many subjects white does as well as any kind of tint, and press them against one of the panes of the window, the film next the glass. On the paper draw roughly a pencil outline of the subject as a guide to the application of the color which may be laid on the paper with a free hand, the photograph giving all the beautiful shading. Bind them together, glass in front and cardboard behind, to keep the film flat, and the color will be found to show through the film with all the beauty of a painting by a good technical artist. I have not tried pasting the film and colored paper together, but think it might be an improvement.

WAR DECREASES COPPER SHIPMENTS OF JAPAN.

If Japanese miners are called upon for military service Japan's output of copper will be materially decreased and prices will go up. While Japan's output is small compared with that of the United States, it is still great enough to influence the market. The consumption of copper is 550 per cent of what is was thirty-four years ago, due greatly to the requirements of electrical engineering, and any decrease in the supply is certain to be felt.

HARVESTING ICE AND ORANGES.

One of the unique features of the Pacific Coast region is witnessed every winter in Nevada county, a little north and east of Sacramento, where a big ice crop has been harvested at Truckee, and within a few miles a big orange crop gathered, both harvests going on at the same time. Nevada county is one of the smallest counties in California, but at Truckee, which lies at an elevation of about 6,000 feet, sleighing, skating and ice cutting were the order of the day during January, while 5,700 feet below strawberries, oranges and roses were being picked, these so widely separated occupations being carried on by the participants almost in sight of one another.

MILLIONS OF RABBITS EATEN.

Rabbits are a terrible pest in Australia. Each year at the "round-up" millions of them are slaughtered. Even pests may be profitable, however, for now the rabbits are being shipped for their fur and meat.

John P. Bray, Consul General at Melbourne, Australia, says: "This industry has become an important one in Australia. Over 20,000,000 rabbits were utilized during the year for export purposes. Of these 1,300,000 were exported frozen in the fur and from 10,000,000 to 12,000,000 skins were shipped and a large number of these animals canned and disposed of."

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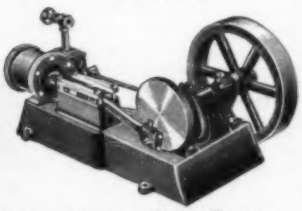

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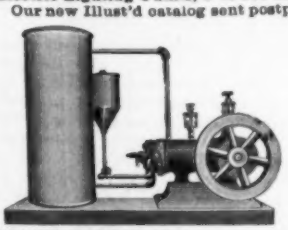

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THE "DEATH DICE."

The German emperor has presented to the Hohenzollern museum the "death dice," with which one of his ancestors decided a difficult case in the seventeenth century. This is their history, told by the Tatler.

A young girl had been murdered. Suspicion fell upon two soldiers, Ralph and Alfred, who were suitors for her hand. Both the accused men denied their guilt, and even torture failed to extract a confession from either of them.

Then Elector Frederick William decided to cut the knot by means of the dice-box. The two soldiers should throw for their lives, and the loser should be executed as the murderer. The event was celebrated with great pomp and solemnity.

Ralph had the first chance and threw sixes, the highest possible number. The dice-box was then given to Alfred. He fell on his knees and prayed aloud.

Then he rose to his feet, and threw the dice with such force that one of them broke. The whole one showed six, the broken one also gave six on the larger portion, and the fragment split off showed one. This was a total of thirteen, one beyond Ralph's throw. The audience held its breath in amazement.

"God has spoken!" cried the prince.

Ralph, appalled by what he regarded as a sign from heaven, confessed his guilt and was sentenced to death.

WOOD AS HARD AS IRON.

There is reposing in the lumber shed of one of the navy yards a stick of lumber that is worthy of the attention it is receiving from the old-time sailors and navigators. It is a piece of live oak, 37 feet long, 4 feet 10 inches wide and a little over 4 feet thick, and has become so hard with age that it requires the finest grade steel to make any impression on it. Its weight is estimated as between twelve and thirteen tons. The stick was originally designed for the stern post of a sister ship to the Hartford, but for some reason was never used. Some of the old tars want the stick cut and sent to a woodworking shop to be turned into pillars to be used in the corridor leading to the officers' quarters on the new battleship Connecticut.

HE CARRIED THE FLAG.

An American who recently took charge of a division of a Mexican railway relates the following incident, which occurred on his first trip of inspection over the line.

The inspection car came up to a trackwalker, who had a wrench in one hand, a machete hung over his shoulder, and carried a green flag in the other hand.

As soon as I saw the green flag he carried I stopped my car and asked him, "Do you work for this company?"

He answered, "Si, Senor" (yes, sir).

"What is your position with the company?"

"I am trackwalker, sir," looking very wise.

"A trackwalker, then, is an official of the road?"

"Si, Senor."

"What is your duty?"

"Oh, nothing, only walk up and down the track."

"What is that you have on your shoulder?" indicating his green flag.

"That is a flag, sir."

"What do you do with that flag? Do you ever use it?"

"No, sir, I never use it."

"Do you know why you are told to carry a flag?"

"No, sir."

"If you don't know why you carry the flag what is the reason that you carry it at all?"

"Well, my foreman told me to carry it, and I am going to carry it."

Attorney-General Cunnen has received a communication from a man in Michigan, who inquires whether electrocution is an effective punishment for the crime of murder. The attorney-general in reply stated that so far as he is aware no man who has suffered that punishment ever again committed murder or any other crime.

Russia has 84,544 public schools, half of which are under the direction of the church. There are 4,400,000 pupils which cost per head, $9.50 for city and $5 for village pupils, per year.

THE
QUESTION OF QUALITY
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Telephones
is
Satisfactorily
Answered

Our instruments are the best that long experience, skilled workmen and a complete equipment can produce. Our prices are the only thing we offer. Let us send you a [illegible]ue that tells all about the best Telephones for Rural Lines and Short Private Lines.

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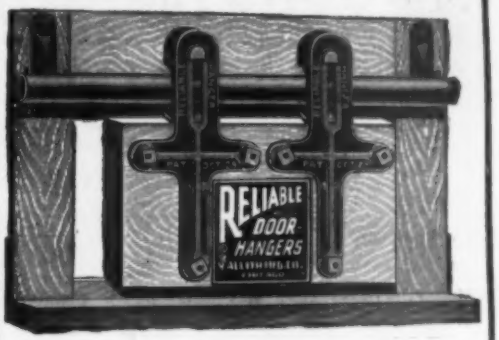

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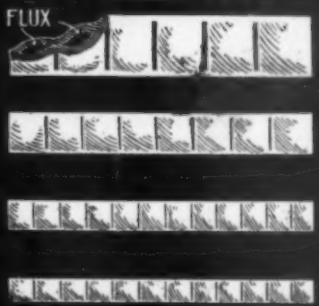

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INVESTOR'S REVIEW, 1461 Gaff Bldg., CHICAGO, ILL.

PROPER METHOD OF BOILING WATER.

Few people know how to boil water properly, although it has much to do with the quality of the beverages for which it is used. Above all fresh water should be used. Have the kettle warm before putting in the water and the fire so quick that the water boils almost instantly. Remove the water as soon as it reaches boiling point, though if the water looks suspicious, five minutes' boiling will be necessary to kill the germs.

"MODERN GROCERIES."

Boracic acid in the soup,
Wood alcohol in wine,
Catsup dyed a lurid hue
By using aniline;

The old ground hulls of cocoanuts
Served to us as spices;
I reckon crisp and frigid glass
Is dished out with the ices.

The milk—the kind the old cow gives
Way down at Cloverside—
It's one-third milk and water, and—
And then—formaldehyde.

The syrup's bleached by using tin,
And honey's just glucose,
And what the fancy butter is
The goodness gracious knows.

The olive oil's of cotton seed,
There's alum in the bread;
It's really a surprise to me
The whole durned race ain't dead.

Meantime all the germs and things
Are buzzing fit to kill;
If the food you eat don't git you,
The goldarned microbes will.

—New Orleans Times-Democrat.

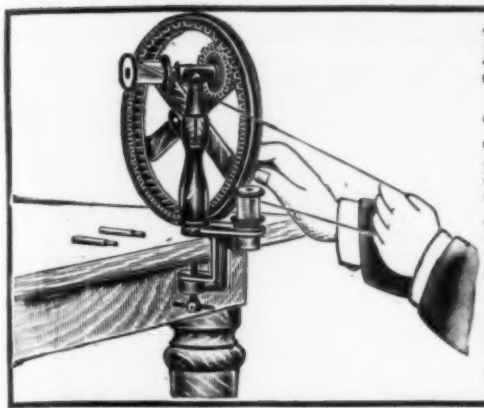
WITH US TO THE END.

Robert Dewhurst, of Bridgewater, Mass., in renewing his subscription writes: "I wish to say I trust to be with you to the end. I have seven boys and two girls and when Popular Mechanics comes they all want it."

ROPES FOR FUNERALS IN CINCINNATI.

In Cincinnati, recently, the thick coating of ice on the hillsides made travel so perilous that a unique scheme was adopted in the case of a funeral. The steep street leading to the residence was a glare of ice and vehicle travel over it was impossible. No attempt was made to take the carriages for the mourners up the hill, and the mourners had to walk to the bottom of the hill to take the carriages. The hearse was another matter. It was taken to the door, and when the casket containing the body had been placed inside, the hearse was let down the hillside by heavy ropes. Even then it required hard work, on the part of those who held the ropes, to prevent an accident.

Dr. William James Morton, the eminent New York physician, claims to have effected three complete cures of cancer by radium, and that two more cases now being treated will doubtless be cured. He said that one of the methods of radium cure of cancer or other diseases internally located is by what amounts to giving the patient liquid sunshine taken internally, or bathing the patient's interior with the rays of sun condensed into liquid form and liberated by the action of radium.



Harvard Magnet Winder

Designed for use in telephone and telegraph offices for unwinding and rewinding Electro Magnets.

The cut shows a Magnet being wound from a spool of wire which is supported on a Stud in the clamp.

A hub like that shown lying on the table is used to support the Magnet, one end of the hub screwing on the spindle of the machine, the other end screwing in the thread in the Magnet Core. The spool and magnet hubs are interchangeable.

To unwind a Magnet it is placed in the stud shown occupied by the spool, and the latter is screwed on the spindle. The operation of winding is clearly shown by the illustration.

It is finished in enamel and striped.

With each winder we furnish a wooden spool, also one 6-32 hub and one 8-32 hub.

PRICE COMPLETE, $3.00 EACH

Harvard Electric Co.

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No. 10 Double Jet Blow Pipe
Capacity 3-4 pint. Weight 2 pounds

NEEDLE FLAME

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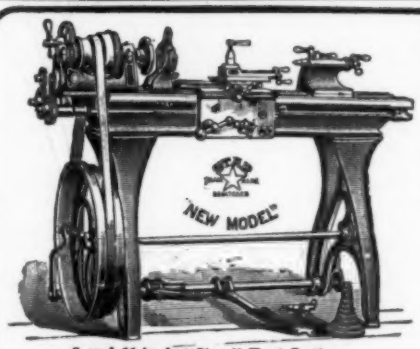

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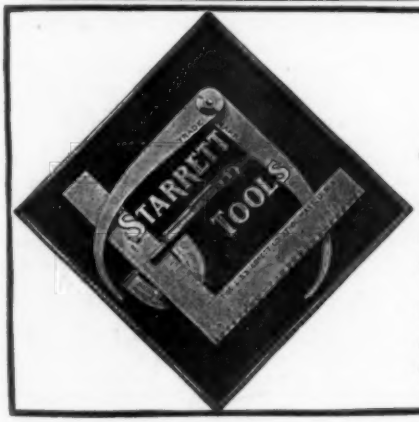

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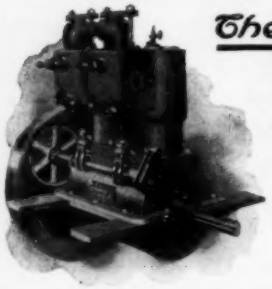

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ANY HORSE POWER for AUTOMOBILE or MARINE

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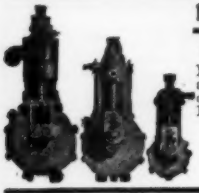

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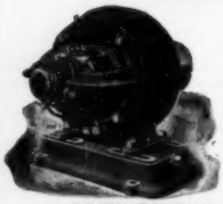

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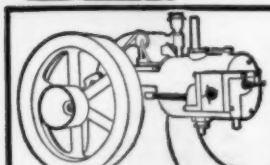

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Stationary, Marine, Portable. Send for catalog

Int'l Power Vehicle Co., 56 W. Wash. St., Chicago, Ill.

COSTLY SNAKE RODS.

Natives of India who wear sandals or go barefoot, resort to a peculiar practice of carrying, for protection against snakes, an iron rod having a knob at one end, a hook at the other end and threaded with a few loose rings. The jingle of the rings against the rod as the native passes along frightens the reptiles out of his path.

H. Hervey, former Government Telegraph Inspector of India, tells of the pilfering of telegraph wire to use for snake rods. The wily Indian chooses a piece of wire strung so low that he can blame the cattle with its destruction. With two pieces of flint he pounds a cross guy loose and then pounds off his length of wire. If the village blacksmith, to whom he takes the bright wand, wonders, he does not betray. Rather he protects his customer from embarrassing inquiries by removing every trace of the bright coating—much to the customer's chagrin.

P. M. SELLS AT SIGHT.

Mr. Will Runcle, book and newsdealer at Albion, Ill., writes the Popular Mechanics a voluntary testimonial as follows:

"I am selling your Popular Mechanics, and all one has to do is to show it to anyone at all interested in mechanics, or who wishes to be posted along this line of study, and you can sell it.

"I have paid but very little attention to your magazine (for in fact most all publications along this line are too deep for the average reader to become at all interested in), and very much to my surprise, I found on looking over the February and March issues of your magazine that they were very entertaining reading, aside from the useful information they contain."

HOW CASTOR OIL IS MADE.

Castor oil is made principally in California, Italy, Mexico and India, but most extensively in California. There are two distinct processes of extracting the oil from the seed, i. e., expression and decoction. While the latter process is adopted in Italy and India, the California manufacturers, and most of the Mexican manufacturers, obtain the oil in the following manner:

After gathering the seed in the fall of the year, they are placed in drying furnaces for an hour or so, for a sufficient time to soften the seeds, as the greater percentage of the oil contained in a seed can be obtained when the seed is soft. After they have been removed from the dryer, they are placed in the press, similar to a cider press, and the seeds are crushed. The oil runs into a large bowl directly beneath this press and is mixed with about an equal portion of water and boiled for one and one-half or two hours—thus precipitating the albumen and other impurities. When cool, there will be a thin scum on top, which is skimmed off. The water and oil are then separated, sometimes by running the water off and sometimes by 'bailing' out the oil, which is placed in the 'sun tanks' (tanks of metal exposed to the sun), where it bleaches for eight or ten hours, and is then removed to the storeroom, where it is placed in barrels, carboys, etc., ready for the market. Some of the trees in California reach a height of fifty feet, and the seeds from one tree contain as much as fifteen gallons of pure oil.

In more northern latitudes the castor oil plant rarely grows higher than three feet, and is used for ornamental purposes, while in warmer countries it becomes a tree.

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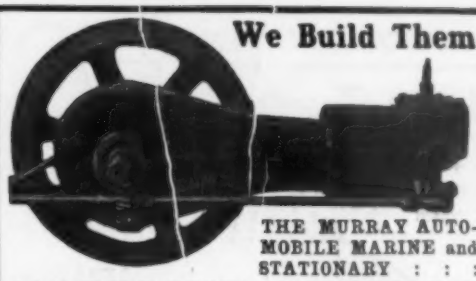

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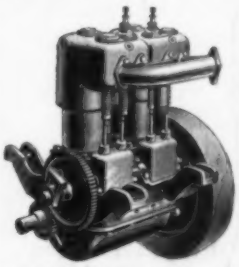

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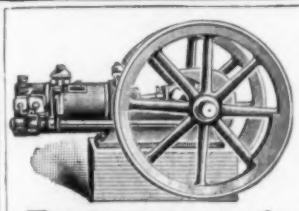

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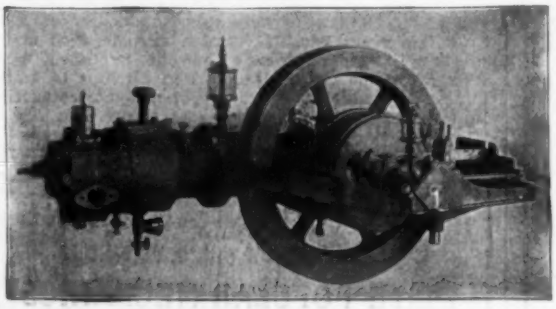

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THE SIGN LANGUAGE.

A farmer was going to town with a load of farm produce and was hailed by a friend and asked as to the contents of his wagon. Says he, "I have three-fourths of a square and a circle complete, a perpendicular on which two semi-circles meet, a right angle standing on two feet, two semi-circles and a circle complete."

The questioner began to make marks in the dust of the road and finally produced this

then looked up and smiled.

ELECTRICITY IN THE SERVICE OF MAN.

Modern Practical Electricity is the first work to give a complete and accurate account of the latest applications of electrical forces which seem to be transforming the industries and science of civilization. The work, carefully edited and handsomely illustrated with 1,000 pictures, tells of electricity in the service of man, and is written by one of the foremost authorities of the day—R. Mullineux Walmsley, D. Sc. (London) F. R. S. E. The author is principal and head of the electrical engineering department of the Northampton Institute, London, and late professor of applied physics and electrical engineering in the Herriot-Watt college, Edinburgh.

The work, which is in four splendid volumes, is a complete history of the electrical science, telling of the early and latest discoveries, inventions and adaptations. It is indispensable to all interested in the world's progress in this—the age of electricity, when electric railways and tramways are springing up on every side, when tube schemes promise a revolution in methods of locomotion; when telephones have permitted the talking across continents; when electric lights have turned night into day in our great cities; when automobiles have enabled men to travel in all parts of the country independent of the horse or railway; when wireless telegraphy wings words on the air across the ocean; when the X-ray renders opaque substances transparent and permits the eye to penetrate the interior organs of animals, and when a hundred things that would have been regarded as miracles a few years ago, are now looked upon as every day matters of course. All these things are related entertaining.y in Modern Practical Electricity. Price $3 per volume, published by W. T. Keener & Co., 90 Wabash avenue, Chicago.

BETTER TELEGRAPH OPERATORS NEEDED.

It is now stated that the standard of efficiency of railroad telegraph operators is not nearly so high as a few years ago. It is also claimed that many of the accidents growing out of mistaken train orders are due to this fact. The attempt to transmit rapidly which is a feature of modern instruction in telegraphy also contributes to errors.

WHEN YOU WANT ANYTHING
AND DON'T KNOW WHERE TO FIND IT
WRITE POPULAR MECHANICS